Navigation Risk Assessment
Brims Tidal Array
(Technical Note)

Prepared by:	Anatec Limited
On behalf of:	Brims Tidal Array Limited
Date:	20 August 2015
Revision No.:	01
Ref.:	A2455-BTAL-NRA-1

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Abbreviations

AfL	-	Agreement for Lease
AIS	-	Automatic Identification System
ALARP	-	As Low As Reasonably Practicable
ALB	-	All-Weather Lifeboat
ATBA	-	Area to Be Avoided
AtoN	-	Aids to Navigation
BTAL		Brims Tidal Array Limited
BWEA	-	British Wind Energy Association (now RenewableUK)
CA	-	Cruising Association
CAST	-	Coastguard Agreement on Salvage and Towage
CD	-	Chart Datum
CNIS	-	Channel Navigation Information Service
COGC	-	Coastguard Operation Centre
CVD	-	Charted Vertical Depth
DECC	-	Department of Energy and Climate Change
DP	-	Dynamic Positioning
EIA	-	Environmental Impact Assessment
ERCoP	-	Emergency Response Cooperation Plan
ETV	-	Emergency Towing Vessel
FSA	-	Formal Safety Assessment
GBS	-	Gravity Base Structures
GIS	-	Geographical Information Systems
GRT	-	Gross Registered Tonnage
HDD	-	Horizontal Directional Drill
HMCG	-	Her Majesty's Coastguard
HSE	-	Health and Safety Executive
IALA	-	International Association of Marine Aids to Navigation and Lighthouses
IHO	-	International Hydrographic Organisation
ILB	-	In-shore Lifeboat
IMO	-	International Maritime Organisation
km	-	kilometre
kV	-	kilovolt
LAT	-	Lowest Astronomical Tide
m	-	metre
MAIB	-	Marine Accident Investigation Branch
MCA	-	Maritime and Coastguard Agency
MCZ	-	Marine Conservation Zone
MEHRA	-	Marine Environmental High Risk Area
MGN	-	Marine Guidance Notice
MOC	-	Maritime Operations Centre
MoD	-	Ministry of Defence
MRCC	-	Maritime Rescue Coordination Centre
MRSC	-	Maritime Rescue Sub Centre

MSI	-	Maritime Safety Information
MS-LOT	-	Marine Scotland Licensing Operations Team
MSS	-	Marine Scotland Science
MW	-	megawatt
NLB	-	Northern Lighthouse Board
nm	-	nautical mile
NOREL	-	Nautical and Offshore Renewable Energy Liaison
NRA	-	Navigational Risk Assessment
OCT	-	Open Centre Turbine
ODBOA	-	Orkney Dive Boat Operator’s Association
OFA	-	Orkney Fisheries Association
OIC	-	Orkney Islands Council
OREI	-	Offshore Renewable Energy Installation
OSF	-	Orkney Sustainable Fisheries
PBD	-	Project Briefing Document
PFOW	-	Pentland Firth and Orkney Waters
PHA	-	Preliminary Hazard Analysis
PIANC	-	Permanent International Association of Navigation Congresses
PLL	-	Potential Loss of Life
PLN	-	Port Letter Number
REZ	-	Renewable Energy Zones
RIB	-	Rigid Inflatable Boat
RNLI	-	Royal National Lifeboat Institution
ROV	-	Remotely Operated Vehicle
RUK	-	RenewablesUK
RYA	-	Royal Yachting Association
SAR	-	Search and Rescue
SFF	-	Scottish Fishermen’s Federation
SPFA	-	Scottish Pelagic Fishermen’s Association
SNH	-	Scottish Natural Heritage
SSB	-	Subsea Base
SSER	-	SSE Renewables (Holdings) UK Limited
STS	-	Ship-to-Ship
TCE	-	The Crown Estate
THLS	-	Trinity House Lighthouse Service
UK	-	United Kingdom
UKC	-	Under Keel Clearance
UKHO	-	United Kingdom Hydrographic Office
VLCC	-	Very Large Crude Carrier
VMS	-	Vessel Monitoring System
VTS	-	Vessel Traffic Service
WGS	-	World Geodetic System

Terminology

- Allision: When a moving object strikes a stationary object (this term has been used where a vessel strikes an underwater turbine)

- Collision: When two moving objects strike each other (this terms has been used where a vessel strikes another vessel.

1. INTRODUCTION

1.1 Background

Anatec was commissioned by Brims Tidal Array Limited (BTAL), a joint venture between OpenHydro Site Development (OpenHydro) Limited and SSE Renewables (Holdings) UK Limited (SSER), to perform a shipping and navigation assessment of the proposed Brims Tidal Array, south of the Islands of Hoy and South Walls in Orkney.

In 2010, The Crown Estate (TCE) awarded an Agreement for Lease (AfL) for the development of a tidal energy array of up to 200 megawatts (MW) in capacity. In 2013 a revision was made to the original site boundary, along with this boundary change, the name of the site was revised from Cantick Head Tidal Development to Brims Tidal Array.

The report presents information on the proposed development relative to the baseline navigational activity and features for the area. Following this, an assessment of the impact of the proposed development on navigation is presented. The assessment forms part of the Environmental Impact Assessment (EIA).

1.2 Navigational Risk Assessment Purpose

An EIA is a process which identifies the potentially significant environmental effects of proposed developments, both negative and positive, in accordance with EU Directives. A key requirement of the EIA is the Navigational Risk Assessment (NRA). Following the Department of Energy and Climate Change (DECC) and Maritime and Coastguard Agency (MCA) guidance (DECC, 2013), an NRA for the Project has been undertaken and includes:

- Overview of base case environment;
- Maritime traffic survey;
- Implications of Offshore Renewable Energy Installations (OREIs);
- Assessment of navigational risk pre- and post-development of the proposed Brims Tidal Array;
- Formal Safety Assessment (FSA);
- Implications on marine navigation and communication equipment;
- Cumulative impacts assessment;
- Identification of mitigation measures;
- Search and Rescue (SAR) planning; and
- Through life safety management.

The assessment reviews the following phases:

- Pre-construction;
- Construction;
- Operation and maintenance; and
- Decommissioning.

1.3 NRA Methodology

Figure 1.1 illustrates the NRA methodology which was used in this study. This methodology was designed by Anatec to meet the guidance described in Section 2.

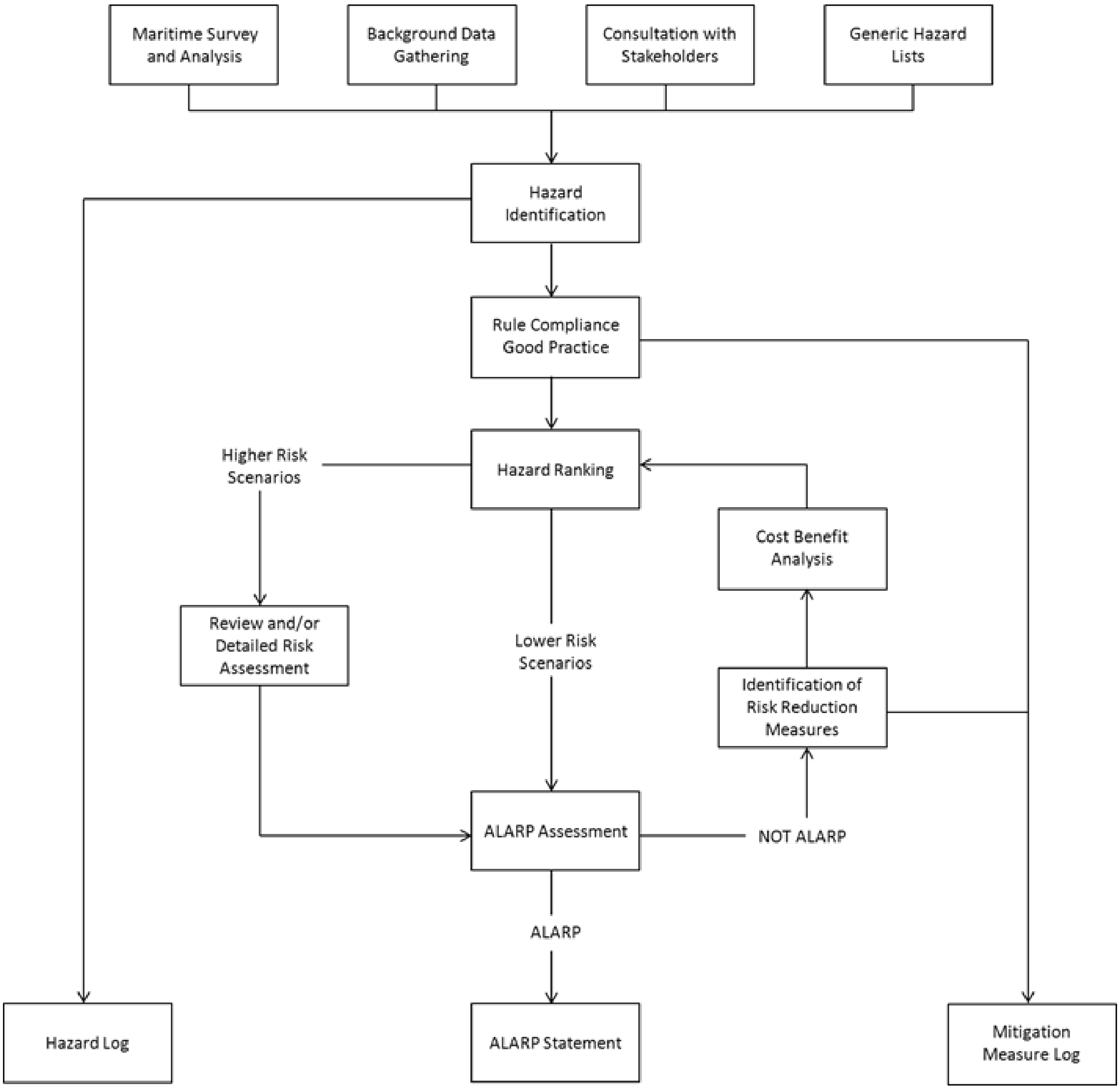


Figure 1.1 Overview of Methodology for Navigational Assessment

2. GUIDANCE, LEGISLATION AND CONSULTATION

2.1 Introduction

The primary guidance documents used during the assessment are listed below:

- Maritime and Coastguard Agency (MCA) Marine Guidance Notice 371 (MGN 371 Merchant + Fishing) Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response Issues (MCA, 2008a):
- Department of Energy and Climate Change (DECC, 2013) in Association with MCA Guidance on the Assessment of Offshore Renewable Energy Installations (OREI) - Methodology for Assessing Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI) (2013); and
- Guidelines for Formal Safety Assessment (FSA) – MSC/Circ. 1023 (IMO, 2002).

Other guidance, including the MCA Under Keel Clearance Policy Paper (UKC) (NOREL 2014) and the International Association of Marine Aids to Navigation and Lighthouses (IALA) guidelines (IALA, 2013) are detailed. The MCA's OREI Compliance with SAR Requirements is also referred to.

2.2 MCA Marine Guidance Notice 371

MGN 371 highlights issues to be taken into consideration when assessing the effect on navigational safety from offshore renewable energy developments, proposed within United Kingdom internal waters, territorial sea or Renewable Energy Zones (REZ).

MGN 371 contains five annexes as follows:

- Annex 1: Considerations on site position, structures and safety zones.
- Annex 2: Navigation, collision avoidance and communications.
- Annex 3: MCA shipping template, assessing wind farm boundary distances from shipping routes.
- Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning.
- Annex 5: Standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around an OREI.

A checklist referencing the sections in this report which address MCA requirements is presented in Appendix C.

2.3 DECC Methodology

DECC produced a Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms in association with the MCA and the DECC (DECC, 2013).

Its purpose is to be used as a template by Developers in preparing their navigation risk assessments, and for Government Departments to help in the assessment of these. Although the title states wind farms it is also applicable to offshore tidal energy developments.

The Methodology is centred around risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows that sufficient risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with further controls or actions.

The key features of the Marine Safety Navigational Risk Assessment Methodology are risk assessment (supported by appropriate techniques and tools), creating a hazard log, defining the risk controls (in a Risk Control Log) required to achieve a level of risk that is broadly acceptable (or tolerable with controls or actions), and preparing a submission that includes a Claim, based on a reasoned argument, for a positive consent decision.

Table 2.1 Key Features of the DECC Methodology (DECC, 2013)

1	Define a scope and depth of the submission proportionate to the scale of the development and the magnitude of the risk
2	Estimate the "base case" level of risk
3	Estimate the "future case" level of risk
4	Create a hazard log
5	Define risk control and create a risk control log
6	Predict "base case with wind farm" level of risk
7	Predict "future case with wind farm" level of risk
8	Submission

2.4 Formal Safety Assessment Process

The IMO Formal Safety Assessment process (IMO 2002) approved by the IMO in 2002 under SC/Circ.1023/MEPC/Circ392 has been applied within this study. This is a structured and systematic methodology based on risk analysis and cost benefit analysis (if applicable).

There are five basic steps within this process:

1. Identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes);
2. Assessment of risks (evaluation of risk factors);
3. Risk control options (devising regulatory measures to control and reduce the identified risks);
4. Cost benefit analysis (determining cost effectiveness of risk control measures); and
5. Recommendations for decision-making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control measures).

Figure 2.1 is a flow diagram of the FSA methodology applied.

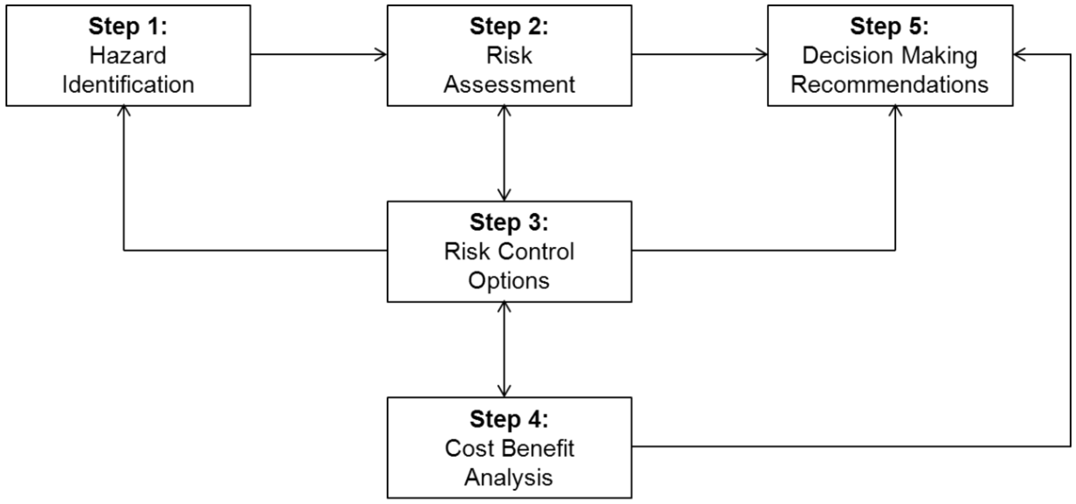


Figure 2.1 Formal Safety Assessment Process

The impact assessment uses information within the baseline assessment to assess impacts as per the Formal Safety Assessment process.

- Hazard log and risk ranking;
- Quantified navigational risk assessment for selected hazards;
- Base case and future case risk levels assessed for selected hazards;
- Emergency response review; and
- Assessment of mitigation measures.

The main part of the impact assessment covers the potential impacts to commercial vessels, fishing vessels and recreational vessels from the construction / installation and presence of the proposed offshore tidal farm and associated infrastructure including the offshore export cable.

2.5 MCA Under Keel Clearance Policy Paper

The MCA has published a policy paper on under keel clearance (UKC) (NOREL 2014) which it intends to become part of the Risk Assessment Methodology and MGN 371.

The Paper was developed by the MCA to provide guidance to developers in determining an appropriate margin of safety to allow adequate safe UKC for mariners - and hence minimum water depth for vessels - transiting over tidal devices (and any associated structures).

A detailed review is presented within Section14.

2.6 IALA

The tidal farm will need to be marked according to International Association of Marine Aids to Navigation and Lighthouses (IALA) guidelines (IALA, 2013). The Northern Lighthouse Board (NLB) exercises control over the marking of Renewable Energy Installations in Scottish waters. The Aids to Navigation (AtoN) required for the site during the different phases of construction, operation and decommissioning will be agreed with NLB.

2.7 Offshore Renewable Energy Installations – Compliance with Search and Rescue Requirements

The MCA is responsible, through HM Coastguard, for the initiation and coordination of civil maritime search and rescue. The layout and spacing of OREIs is a significant factor in enabling air and surface SAR operations to continue within an OREI area. The agreement of the MCA to the construction of an OREI is dependent on the OREI meeting relevant SAR requirements as contained within MGN 371. MCA cannot formally accept an OREI layout meets its SAR requirements unless the layout, orientation and spacing of all structures within the OREI has been discussed in detail with assigned MCA Subject Matter Experts. A layout complying or not complying with SAR requirements will be communicated to the regulatory authorities and will form part of their decision for formal approval for an OREI to be constructed and operated. Developers are advised to make the earliest possible contact with the MCA regarding proposed layouts. The MCA will then indicate a layout meets SAR requirements by submission of a formal letter to the developer, copied to the regulatory authorities.

2.8 Other Guidance

Other guidance documents used during the assessment are listed below:

- MCA Marine Guidance Notice 372 (MGN 372 M+F) Offshore Renewable Energy Installations (OREIs) Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008b);
- Royal Yachting Association (RYA) – The RYA's Position on Offshore Renewable Energy Developments: Paper 3 – Tidal Energy (RYA, 2013);
- The Recreational Craft Directives 94/25/EC and 2003/44/EC - implemented into UK law by the Recreational Craft Regulations 2004 (SI No. 2004/1464) (Great Britain. Parliament, 2004), apply to recreational craft and are intended to ensure the free movement of goods on the EEA market.

2.9 Stakeholder Consultation

A range of stakeholders were consulted during the NRA process. This included the preparation of a Preliminary Hazard Analysis report (Anatec, 2013) which was sent to a wide range of potential stakeholders for comment during EIA Scoping. A Hazard Review Workshop was also held, at Orkney Marine Services Harbour Authority Building, on 3 June 2015, involving a cross-section of local stakeholders identified from the baseline data.

3. DATA SOURCES

3.1 Introduction

This section summarises the main data sources used in assessing the baseline shipping activities relative to the Brims Tidal Array.

3.2 Baseline Data Summary

The main data sources used in this assessment are listed below.

- Maritime Traffic Survey Data – 2 x 14 Days (with the first and last days being half days).
  - Winter 2013 (14 Days) (22 November to 6 December 2013)
  - Summer 2014 (14 Days) (28 May to 11 June 2014).
- Admiralty Sailing Directions – North Coast of Scotland Pilot, NP 52 (UKHO, 2009).
- Clyde Cruising Club Sailing Directions and Anchorages – N & NE Scotland and Orkney Islands (Clyde Cruising Club Publications, 2010).
- UK Coastal Atlas of Recreational Boating (2009) and Geographic Information Systems (GIS) Shapefiles (RYA, 2010).
- Fishing Data.
  - Sightings data for 2012-2014, from Marine Scotland Compliance.
  - Satellite vessel monitoring system (VMS) data for 2012-2014, from Marine Scotland Compliance. (Satellites record the positions of fishing vessels of 15m length and over a minimum of every two hours).
  - TCE Succorfish Data for October to December 2014 (data covering a wider temporal extent are analysed in the Commercial Fisheries ES Chapter), characterising the spatial distribution of the Orkney creel fishery.
  - Marine Scotland ScotMap data for 2007-2011, representing the distribution of fishing vessels under 15m in length.
  - Commercial Fisheries ES Chapter.
- Maritime Incident Data.
  - Marine Accident Investigation Branch (MAIB) data for 2004-2013.
  - Royal National Lifeboat Institution (RNLI) data for 2001-2010.
  - Royal National Lifeboat Institution (RNLI) data for 2010-2015.
- Offshore Renewables Shapefiles (TCE, 2014).
- Marine Environmental High Risk Areas (MEHRA) (DfT, 2006).
- UK Admiralty Charts:
  - 1954-0 Cape Wrath to Pentland Firth including the Orkney Islands; and
  - 2162-0 Pentland Firth and Approaches.

3.3 Maritime Traffic Survey

Baseline shipping activity was assessed using Automatic Information System (AIS), radar track data and visual observations. Data were analysed for two 14 day periods during winter 2103 and summer 2014, in accordance with the requirements of MGN 371, and encompassed seasonal fluctuations in shipping activity and accounted for a range of tidal conditions.

A five nautical mile (nm) buffer surrounding the Brims AfL area was used for analysis of the AIS and radar data providing a suitable area in which to undertake data analysis relative to the development.

AIS is required on board all vessels of more than 300 gross registered tonnage (GRT) engaged on international voyages, cargo vessels of more than 500 GRT not engaged on international voyages, passenger vessels irrespective of size built on or after 1st July 2002, and fishing vessels over 18m in length (at the time of the winter survey) and over 15m in length (at the time of the summer survey). A proportion of smaller vessels also carry AIS voluntarily but may not broadcast continuously. Radar and visual observations were therefore used to record the movements of non-AIS vessels to obtain a complete picture of maritime activity.

3.4 Recreational Activity

The RYA and the Cruising Association (CA) represent the interests of recreational users including yachting and motor cruising. In 2005 the RYA, supported by Trinity House Lighthouse Service (THLS) and the CA, compiled and presented a comprehensive set of charts which defined the cruising routes, general sailing and racing areas used by recreational craft around the UK coast. This information was published as the UK Coastal Atlas of Recreational Boating and has been subsequently updated (RYA, 2009). The latest edition of GIS shapefiles from 2010 showing cruising routes, sailing and racing areas has been used in this assessment. The RYA has also developed a detailed position statement (RYA, 2013) based on analysed data for common recreational craft.

The Clyde Cruising Club Sailing Directions and Anchorages for the North and Northeast Coasts of Scotland and Orkney Islands, and Orkney Marinas sailing guide were also consulted.

Consultation undertaken with recreational stakeholders at all stages of the Project, including the Hazard Workshop, was also considered within the assessment.

The above, along with the recreational vessel data extracted from the maritime traffic survey, were used to inform the NRA.

3.5 Fishing Activity

Fishing vessel data were extracted from the AIS and radar data recorded during the maritime traffic surveys.

In addition, longer term data on fishing vessel sightings, and satellite monitoring data were obtained from Marine Scotland Compliance. These were used to validate the survey data presented in the baseline assessment.

Sightings data were analysed from the 2012-2014 period. These data have been collected through the deployment of patrol vessels, surveillance aircraft and the sea fisheries inspectorate. Each patrol logs the position and details of fishing vessels within the area being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their Port Letter Number (PLN).

Satellites record the positions of fishing vessels of 15m length and over a minimum of every two hours. Data have been analysed from the 2012-2014 period.

Succorfish data were received for the Project, for the period October to December 2014. These data recorded the spatial distribution of the Orkney creel fishery by installing tracking equipment on selected, representative vessels.

Consultation undertaken with fishing stakeholders at all stages of the Project, including the Hazard Workshop, was also considered within the assessment.

Information was also available from the Commercial Fisheries work carried out as part of the EIA, which included consultation with fishermen.

3.6 Lessons Learned

There is considerable benefit in the sharing of lessons learned to developers within the offshore industry. This NRA, and in particular the hazard assessment, includes general consideration for lessons learnt and expert opinion from other studies. Lessons learnt, data sources and expert opinion include:

- RYA & CA. Sharing the Wind - Identification of recreational boating interests in the Thames Estuary, Greater Wash and North West (Liverpool Bay). Southampton (RYA, 2004);
- BWEA. Guidelines for Health & Safety in the Wind Energy Industry – British Wind Energy Association. London: (BWEA (now RUK), 2008);
- The Nautical and Offshore Renewable Energy Liaison (NOREL). (Unknown). A Report compiled by the Port of London Authority based on experience of the Kentish Flats Wind Farm Development. Norel Work Paper, WP4 (2nd NOREL); and
- TCE. Strategic assessment of impacts on navigation of shipping and related effects on other marine activities arising from the development of Offshore Wind Farms in the UK REZ. TCE and Anatec (TCE, 2012).

(It is noted that whilst this is mostly for offshore wind, for which there is much more experience, much of the data is also applicable to offshore tidal energy.)

4. PROJECT DESCRIPTION DETAILS

The scope of this NRA will reflect a Rochdale (Design) Envelope defined by BTAL. The following section details the worst realistic case parameters of the Project against which the effects will be assessed.

4.1 Introduction

The proposed development is a commercial scale tidal energy array of between 100 and 200 tidal turbines with an expected capacity of 200MW. The development of this Project will take place over a period of time, with Project construction being carried out over a number of years.

The capacity of Phase 1 of the Project will be 30MW. Turbines installed in Phase 1 will have individual capacities of at least 1MW, resulting in an array size of up to 30 turbines. The build-out of Phase 1 will take place over up to 18 months, with the first turbines being installed during Q3 2019. A broad outline of the proposed build out strategy is provided in Figure 4.1.

Figure 4.1 Proposed Build Out Strategy

4.2 Location Overview

The AfL area from TCE was awarded for a site off Brims Ness, south of the Islands of Hoy and South Walls in Orkney, to investigate the potential for developing a tidal energy array. It has an area of 3.2nm^2 (10.9km^2). It is located in the northern area of the Pentland Firth, an area of water separating Mainland Scotland and the Orkney Isles.

This AfL area has been revised, with 80% of the area for investigation shifted to the west, and the remaining 20% overlapping with the original site.

A general chart overview of the Brims AfL area can be seen in Figure 4.2.

The northeastern extent of the AfL area overlaps the Limit of Orkney Harbours, with Orkney Islands Council (OIC) Marine Services being the Harbour Authority. Following consultation with OIC Marine Services, BTAL confirmed that no deployment of turbines will occur within the Limit of Orkney Harbours. However, if cable corridor option 1 is developed there will be export cables passing through this area.

The southeastern boundary of the AfL area is approximately 0.9nm (1600m) from the recommended track for deep-draughted vessels to and from Scapa Flow via the Sound of Hoxa. The site has been aligned so that vessels following the recommended track, or wider channel, on a constant course would not enter the AfL area.

The charted water depth (as displayed on Admiralty Chart number 2162-0: Pentland Firth and Approaches) in the AfL area ranges from approximately 65m to 84m. (Depths are reduced to chart datum which is approximately the level of lowest astronomical tide (LAT)).

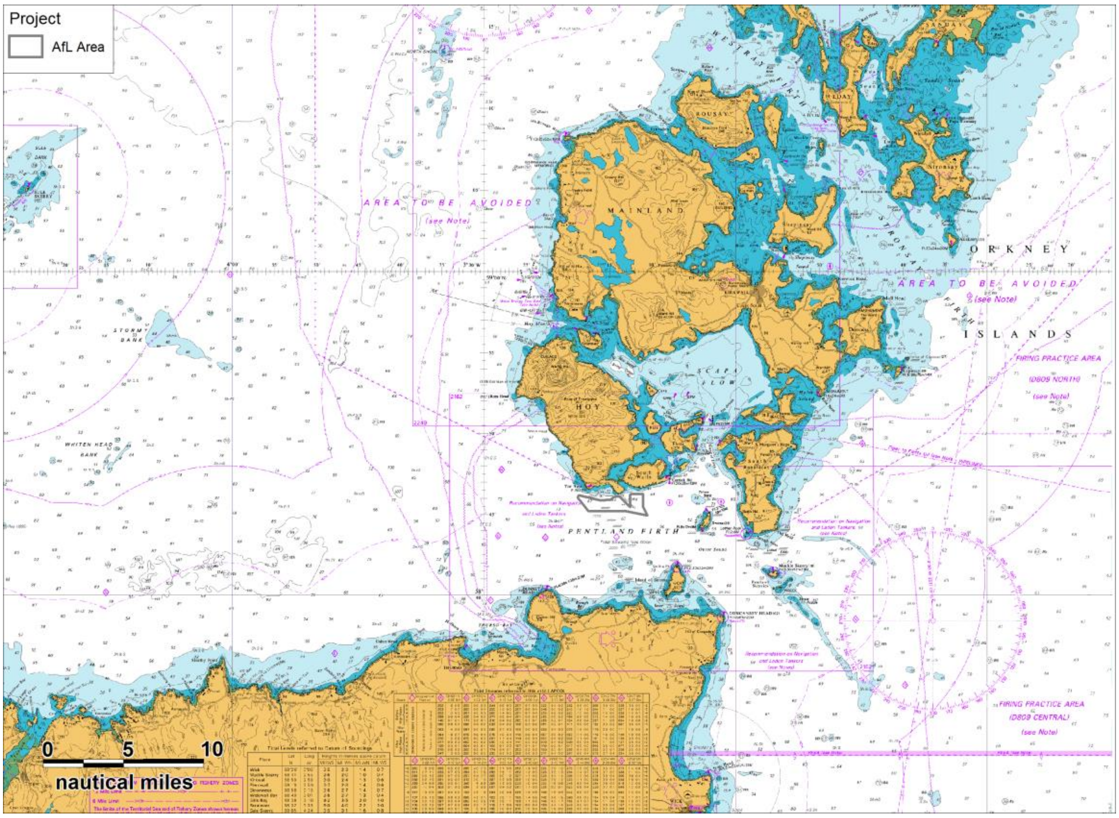


Figure 4.2 General Overview of Brims Tidal Array

A detailed view of the Brims AfL area is presented in Figure 4.3, showing boundaries of Phase 1 and Phase 1 and 2 Development Areas, and cable corridor options. Figure 4.4 presents one potential turbine array layout. The final layout will be dependent on the technology selected and detailed electrical infrastructure design, as well as any environmental concerns/requirements.

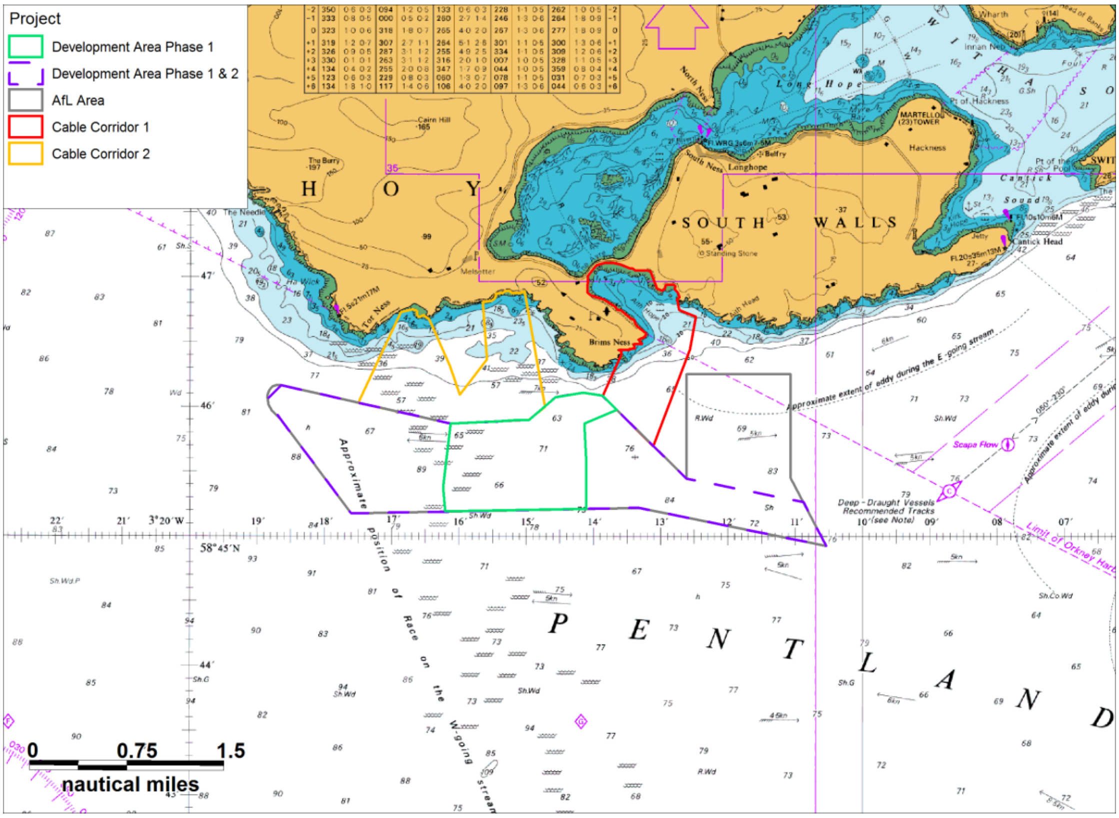


Figure 4.3 Detailed Overview of Brims Tidal Array

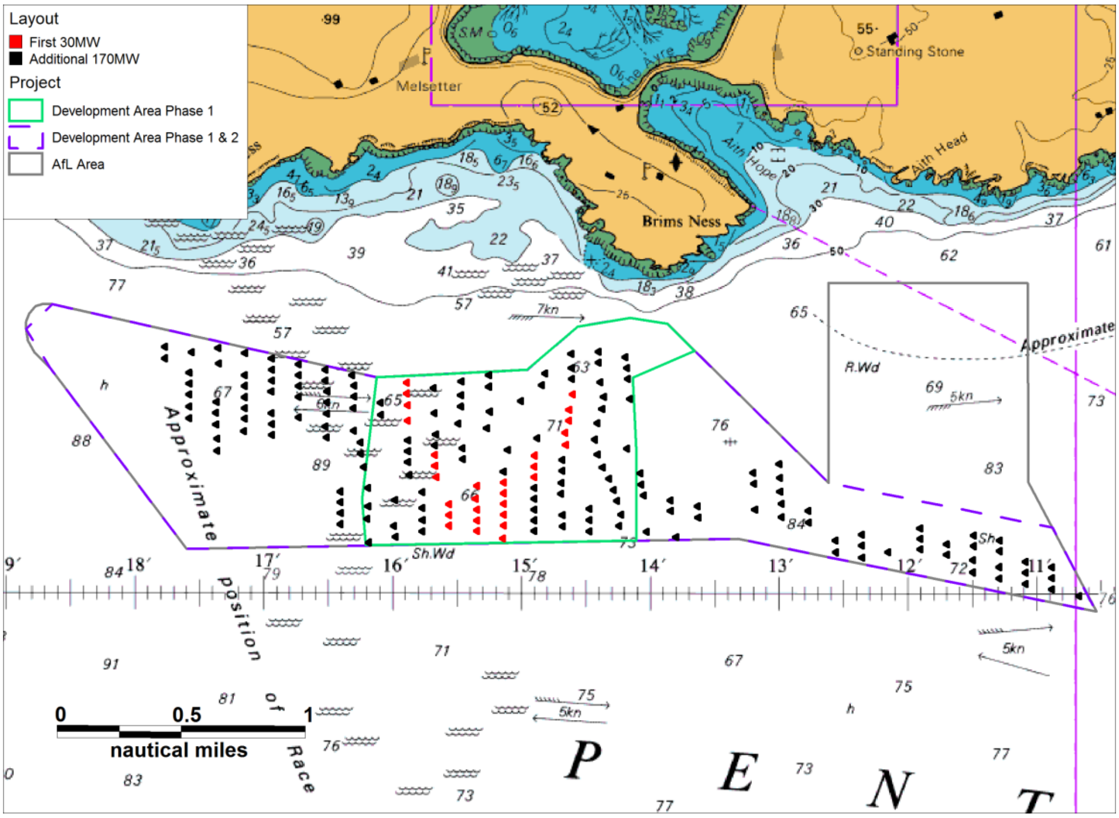


Figure 4.4 Indicative Layout Overview of Brims Tidal Array

The corner coordinates of the Brims AfL area are presented in Table 4.1 with Figure 4.5 presenting the corresponding points.

Table 4.1 Brims AfL Area Corner Coordinates (WGS84Z30N)

Point	Latitude (Y)	Longitude (X)
A	58.7694°	-3.3122°
B	58.7685°	-3.2361°
C	58.7709°	-3.2104°
D	58.7709°	-3.1846°
E	58.7575°	-3.1845°
F	58.7488°	-3.1758°
G	58.7537°	-3.2220°
H	58.7529°	-3.2934°
I	58.7669°	-3.3142°

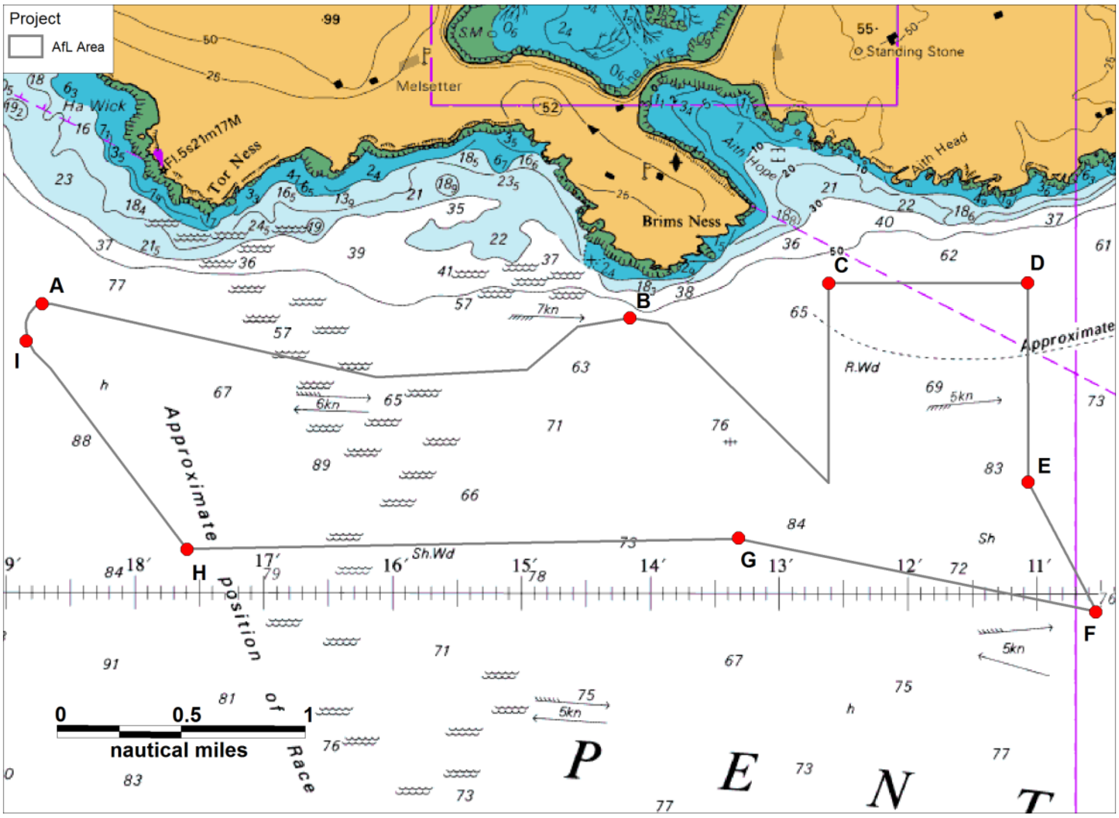


Figure 4.5 Corner Coordinates of Brims Tidal Array AfL Area

4.3 Technology

4.3.1 Design Envelope

A design envelope (Rochdale Envelope) approach has been applied to the assessment. The basis of the design envelope is to apply a "worst case" approach to the assessment of the different impacts associated with the Project.

Applying a design envelope approach to the EIA allows for the evolution of specific elements of the Project design such as turbine technology, site design, layout and electrical infrastructure to continue beyond submission of the Marine Licence application. This flexibility is important at this stage of development in the tidal technology industry as it mitigates the risk that a specific technology might become unavailable or is superseded by the time of construction.

The purpose of the design envelope is to define a series of realistic design parameters that encompass all possible technological, engineering and design options that will be considered as the Project continues to evolve. The realistic design parameters must encompass all possibilities while providing sufficient detail to allow for a robust EIA. This ensures that the maximum potential benefits and adverse effects of the Project have been fully assessed whilst preserving sufficient design flexibility. The design envelope approach also allows for alternatives to be considered and documented as part of the impact assessment.

The approach will require that the impact assessment encompasses all potential technologies, and may therefore require that impacts from a number of different scenarios are assessed separately, depending on the receptor. The approach allows the developer to maintain the necessary level of flexibility at the consenting stage, while ensuring that the assessment made in the EIA reflects the worst level of impact under any development scenario.

In finalising the design envelope, BTAL considered comments made by Marine Scotland and their statutory advisors in the Scoping Opinion received in 2013 as well as comments made in a review of the draft Project Description that was submitted in early 2015. The project envelope has therefore been refined relative to that proposed in Scoping and is presented below.

4.3.2 Turbine Specification

The design parameters relating to the turbines described below have been developed specifically to encompass a range of parameters associated with turbine technology options that could be considered for the Project. Figure 4.6 and Figure 4.7 present the turbine type options.

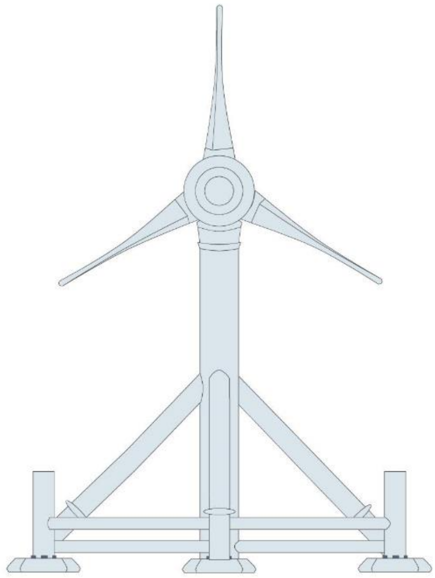


Figure 4.6 Turbine Type – Unshrouded Seabed Mounted

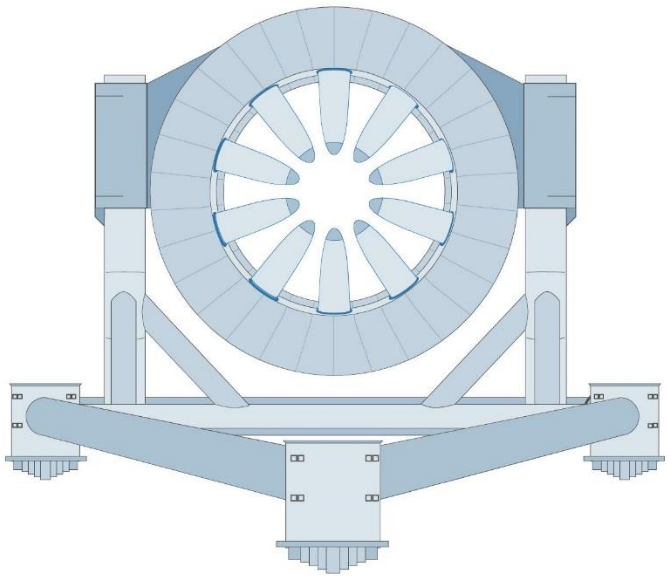


Figure 4.7 Turbine Type – Shrouded Seabed Mounted

All device types will be seabed-mounted and will have minimum clearance from the blade tip to sea surface at LAT of 30m. Turbines will have a minimum clearance from the blade tip to the seabed of 4m.

To generate electricity the turbines will convert kinetic energy from the flow of water into electrical energy via the turbine blades turning the generator. The turbines being considered are bi-directional, using either active or passive approaches:

- Active: Uses a yaw system to re-orientate rotor blades during slack tide in order to optimise tidal flow from both ebb and flood tides; and
- Passive: has fixed pitch blades which generate energy from flows in both directions (ebb and flood tides).

Some turbines also have independent blade pitching which can be modified to optimise tidal flows in different directions.

The rated power output of the turbines depends on a number of factors including technological developments, site conditions and array layout. For the purpose of this assessment, it is assumed that all turbines will have a rated power output of at least 1 MW. Given that the maximum capacity of the AfL area is 200 MW, the total number of turbines required for the Project will decrease as the rated power of the tidal turbines increases. For example, if the turbines have a rated power output of 2 MW only 100 turbines will be required.

All turbines have a design life of between 20 and 25 years. Rotor diameter will be 13m – 23m. All devices will be single rotor, with 3 (unshrouded turbines) to 10 (shrouded turbines) blades per rotor. There will be a minimum 30m clearance between blade tip and sea surface at LAT.

4.3.3 Turbine Support Structures

The design of the Turbine Support Structures (TSS) varies according to the different turbines being considered and method of attachment to the seabed. Summary of options that will be considered include:

- Gravity base structures (GBSs), including sub-sea bases (SSBs);
- Drilled pin pile tripod
- Drilled monopile

<u>Gravity Base including Sub-Sea Bases</u>
GBSs (see Figure 4.8), are steel or concrete (or a combination of both) structures that use their own weight to attach to the seabed. The GBSs considered for this Project comprise either a three-point structure constructed from steel with ballast fill material as in the sub-sea base (SSB) or a combination of steel and concrete with a flat bottom that sits on the seabed. The footprint of the flat bottomed GBSs is 30m by 40m and therefore will have a maximum footprint of 1,200 m^2 per gravity base. The footprint of the three-point subsea base is 37.5 m2 as there are only three points that are in contact with the seabed. The total weight of the structures will vary depending on current speeds with increased weight and ballast required in higher energy environments.

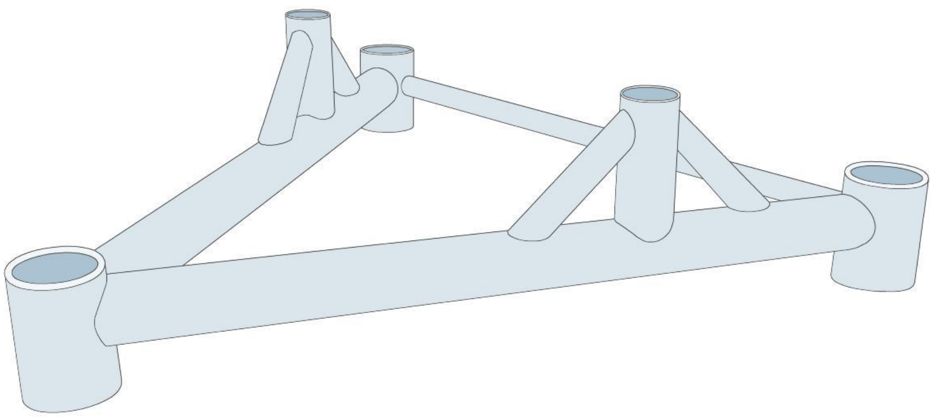


Figure 4.8 Turbine Support Structures – Gravity Subsea Base

Drilled Pin Pile Tripod

This method of attachment involves placing a braced steel tripod structure onto three pre-drilled pin piles which have been fixed in place with high strength grout, as presented in Figure 4.9. The tripod structure is then grouted onto the pin piles for extra stability. The pin piles will have a diameter of 1.3m with a depth of 5m. The total footprint of each pin pile will be 1.3m^2. Therefore the total footprint for three pin piles will be 4m^2. The maximum area of seabed occupied by each tripod structure (lattice and pin piles) would be 154m^2 although not all sections of the tripod will have direct contact with the seabed (part of the tripod structure will be raised slightly above the seabed).

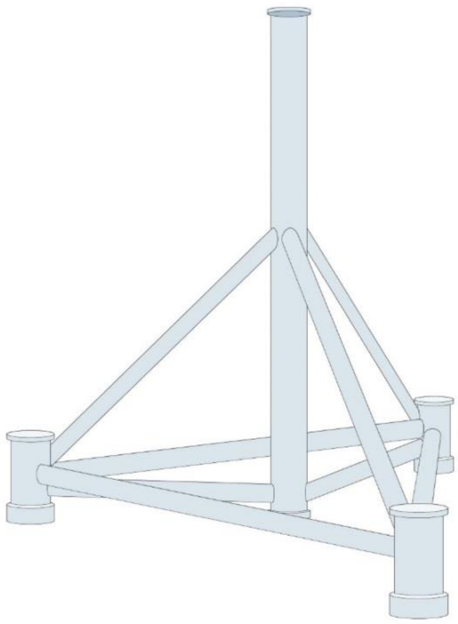


Figure 4.9 Turbine Support Structures – Pin Pile Tripod

Drilled Monopile

Drilled monopiles, Figure 4.10, are single cylindrical steel structures (piles) that are drilled into the seabed. Cylindrical steel transition pieces may also be required to attach the turbine to the monopile. The transition piece would be held in place over the top section of the monopile by an ROV actuated clamp. The turbine would then be winched down onto the top of the transition piece and locked in place with a series of clamps.

The diameter of the hole required for the monopile will vary depending on turbine type but is expected to range between 2.5m to 3m diameter and up to 12m deep. The height of the monopile, including the transition piece, ranges from 14m to 23.5m, depending on selected height of the turbine axis. The footprint for the monopile will range from 5m^2 to 7m^2. With the transition piece (which may extend both above and below the seabed) the total footprint of the monopile would be 20m^2. Once the monopiles have been installed they will be fixed in place with high strength grout.

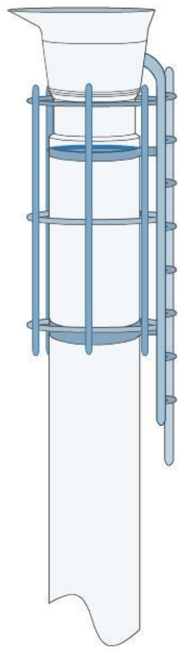


Figure 4.10 Turbine Support Structures – Monopile

4.3.4 Array Layout

Final turbine layout will not be determined until design stage (post consent). An indicative turbine layout has been used to inform the impact assessment. The positioning and layout of the turbines will be influenced by site characteristics, turbine characteristics and will have to take into account spacing for both cross flow and down flow. Minimum cross flow spacing for the different turbine ranges will be 80m. Minimum down flow spacing will be 150m. Both cross and down flow spacing will be influenced by resource availability, seabed conditions and rotor diameters.

To optimise resources within the AfL area the turbines will be arranged in rows aligned perpendicular to the tidal flow. The total number of turbines per row, and number of rows, will only be determined once the preferred turbine technology has been identified. Based on the pattern of tidal flow through the AfL area, it is likely that the total number of turbines per row would not exceed 15 turbines. In some parts of the AfL area, the total number of turbines per row may be limited to 1 or 2 turbines only, due to reduced resources and/or seabed conditions. The total number of rows is expected to range between 10 and 40 depending on turbine type, number of turbines per row, resource availability and seabed conditions.

4.3.5 Electrical Infrastructure

Each turbine will require its own inter array cable. Each inter array cable will have a transfer voltage of up to 33 kV and a diameter of up to 500 mm. Depending on the rated output of the turbines (at least 1MW) for a 200MW array the total number of inter array cables required would be 200. The number of inter-array cables required for a 200 MW project will decrease as the rated power output of the tidal turbines increases. Cables may be bundled to reduce the overall footprint of the inter array cables.

The inter array cables will be surface laid. This is necessary to provide flexibility for the cables to be picked up during maintenance. The cables may be anchored to the seabed to hold them in position during operation. The cables may include armour protection (possible double armour or interlocking armoured shells as used in the oil and gas industry) to provide mechanical protection and add additional weight to the cables which will help to hold the cables in position.

4.3.6 Subsea Cable Connection Hubs

A series of subsea cable connection hubs will be used to collect inter-array cables for connection into the export cables. It is expected that a maximum of eight subsea cable connection hubs will be required.

4.3.7 Export Cables

It is anticipated that up to 16 export cables (4 for Phase 1) may be required to connect the tidal array to shore. In this case, each cable will have a voltage of at least 33kV, but potentially up to 132kV, and a diameter up to a maximum of 500mm.

The export cables will be surface laid as much of the seabed within the AfL area and along proposed export cable routes comprises hard rock substrate limiting cable burial. Given that the cables cannot be buried cable protection may be required along the full length of the export cables (from the AfL to landfall). This will also ensure cable stability in sections where the cables run perpendicular to the tidal flow.

Cable protection measures may include:

- Rock placement: placement of rocks and boulders of various size along the export cables resulting in the creation of a rock berm over the cable. The size and dimensions of the berm will depend on local bathymetric and tidal conditions. Rocks will be placed along the cable by a specialised vessel with a ROV controlled fall pipe to ensure accurate rock placement;
- Concrete mattresses: pre-formed articulate mattresses comprising a mesh of concrete block that are placed across cables. The thickness of protection provided can be increased by stacking a few mattresses on top of each other; or
- Grout bags: bags of hardened gravel, sand / cement grout or concrete placed over the cable. Grout bags can be pre-fabricated onshore or bags can be filled offshore using vessels with fall pipes.

Including cable protection, the maximum width of the area of seabed affected by each export cable will be 5m. For 16 cables, the total width of the area of seabed directly affected by the cables will be 80m. The affected area for Phase 1 will be up to 20m. For operational reasons, a space will be required between each subsequent cable. The required spacing will be dependent on the water depth at each location. As a result, the corridor width associated with the cables will be significantly wider than the cable affected area.

In areas of softer sediment e.g. towards the landfalls there may be options for cable burial (trenching).

4.3.8 Export Cable Corridors Area of Search

The number and size of export cables will depend on a range of factors, including array size, rated output of selected turbines, inter-array cable layout / configuration, number and size of subsea cable connection hubs, seabed condition, redundancy, landfall and export cable routes and options for bundling cables along export cable corridors. The final cable architecture will be designed to ensure the following:

- Turbines are fully maintainable during service without any effect on the output from other turbines;
- Turbines can be removed without any effect on the output from other turbines; and
- The power output from the turbines must not be affected if any cables are damaged.

The export cables will be brought to shore at one of three possible landfall locations; Sheep Skerry (2.5km to AfL area), Moodies Eddy (2.6km to AfL area) or Aith Hope (6.5km to AfL area). Indicative cable corridors provide access to each of the landfall locations.

The preferred export cable route and final alignment and width of the preferred route will be determined during detailed design.

4.3.9 Cable Landfall

Export cables will be brought to shore using either open cut trench technique or horizontal direction drill (HDD) techniques. The size of the cable landfall at each of the three possible locations (Sheep Skerry, Moodies Eddy and Aith Hope) will depend on the number of export cables to be brought ashore and the selected landfall technique (open cut trench or HDD). For 16 export cables in 6 bundles, assuming 15m separation between cable bundles, the maximum width of the corridor at the landfall (assuming cables are not buried) will be 85 m.

Open Cut Trench

For sea to shore landfall construction, the open cut method requires the excavation of a trench which is then back-filled following installation of the cable. For landfalls the trench is divided into two sections which consider an onshore portion and an offshore portion. Specialist dredging / trenching equipment would be required for the offshore section to successfully protect the cable below the high energy littoral zone.

The depth of excavation is dependent on site morphology and coastal processes, and that the open trench can remain stable and 'open' long enough to achieve the cable installation before burial. Once a trench has been formed, the offshore cable can be installed from the cable lay vessel by a combination of floating and pulling the cables ashore using a pulling head from a land-based winch.

Horizontal Directional Drill

In coastal areas that are not suitable for open cut trench, HDD is the alternative method. HDD involves drilling a hole at depth through the ground linking two points between which the cable will be installed; these are referred to as the entry and exit points, with the drilling rig being set up at the entry point. A solid conduit or duct will then be inserted into the hole to keep the hole open. The cables will then be pulled through the conduit / duct. Cables can be pulled from either an onshore or offshore direction. The size and number of the HDD holes / ducts will depend on the size and number of cables requiring installation. The length and depth of the HDD ducts will depend on the mechanical properties of the submarine cables and the shore and nearshore conditions (geology and geotechnical) to be drilled under. Selection of the preferred landfall location will depend on the preferred export cable route.

4.4 Offshore Installation Phase

4.4.1 Duration of Installation

Turbine support structure and turbine installation will occur over three years. Phase 1 (15 to 30 turbines) will commence in Q2 2019 and will continue for approximately 24 months to the end of Q1 2021. Phase 2 (85 to 170 turbines) will commence at the beginning of Q2 2021 and will continue for approximately 36 months with expected completion in Q2 2024. For both phases turbine installation will commence at the same time as installation of the export cables. Turbine installation will either be carried out at the same time as installation of the turbine support structures or will follow turbine support structure installation. The inter array cables will also be installed at the same time as the turbines.

All timescales provided above are approximate and are dependent on seabed and tidal flow characteristics within the AfL area and weather conditions at the time of installation.

Where moored barges or jack-up barges are to be used to assist with turbine support structure and turbine installation, these will need to be anchored / positioned within the AfL area. The positioning of anchors / location of the jack up barge will depend on seabed conditions and array configuration.

During turbine support structure and turbine installation, there may be requirements for vessels to take temporary shelter during periods of bad weather or between tides. Possible locations to be used as sheltered anchorages will be confirmed prior to submission. The final preferred location will be identified through consultation with key stakeholders during detailed design.

4.4.2 Turbine Installation

Once the turbine support structures are in place (for those that don't have turbines pre-attached), the turbines will be transported to the AfL either on a dedicated deployment barge or heavy lift vessel. Turbines with built in buoyancy will be towed to site using standard working class tow vessels.

Once the turbines are at site they will be lowered (or pulled down for buoyant turbines) by a winch to the top of the turbine support structures. ROVs will then be used to guide the turbines into place for attachment to the turbine support structures. The turbines will then be mechanically secured in place.

Turbines that are to be installed as a single unit (already attached to the turbine support structure) will be assembled on dry land (e.g. port facility) before being loaded onto the deployment vessel and transported to the AfL area. Once at the AfL the entire turbine unit will be lowered into position on the seabed using three specialised deck mounted heavy lift winches. A specially designed steel recovery frame and lifting system can also be used to assist with the positioning of the single unit turbine structures on the seabed. The recovery and lifting frame can be attached to the deployment barge using a hydraulic winch system.

Although there are no specific seasonal constraints on turbine deployment, turbine installation and other construction activities will generally be carried out during months when weather is most favourable (e.g. April to September / October). Turbine support structure and turbine installation will generally take place around slack water periods on a neap tide in sea state 4 or less.

4.4.3 Installation Vessel Requirements

Some of the turbine support structures and turbines will be installed using a Dynamic Positioning (DP) construction vessel with a 250 to 400 tonne capacity heave compensated crane or an equivalent stable platform (moored barge). A jack up barge may also be required depending on site conditions, turbine support structure and precise method of installation. Where turbines and turbine support structures are to be installed as a single unit installation will be carried out using purpose built twin hulled three point heavy lift deployment barge. Other smaller vessels e.g. tugs, vessels carrying ROVs, crew transfer vessels, dive boats and RIBs will also be required to support the installation operations. There will be limited / no requirements for any seabed preparation e.g. levelling or infill prior to the installation of the turbine support structures.

4.5 Offshore Operations and Maintenance Phases

4.5.1 Duration of Commissioning

For all turbines the majority of commissioning work will be carried out onshore to minimise the amount required offshore. However, once installed final commissioning of the turbines will be required. Initial commissioning of the first installed turbines could take up to 2 months. Following this commissioning of individual turbines is expected to take between 1 day and 1 week. Where possible, individual turbines will be commissioned concurrently to minimise impacts on the duration of overall commissioning period. Commissioning of Phase 1 is expected to start at the end of Q2 2019 for completion at the end of Q3 2019. Commissioning of Phase 2 will commence Q2 2021 for completion by end of Q3 2023.

4.5.2 Operations and Maintenance

The array will have an operational life of 20 - 25 years. The turbines will be controlled remotely via an onshore control system. This control system will be located at a dedicated operations base, the location of which is still to be determined. It is planned that the operating system will be unmanned and will run automatically.

The turbines will also contain on-board monitoring systems including sensors and other monitoring equipment that will alert the operator to any operating anomalies. It is planned that the turbines will be monitored continually throughout their operational life. In the event that anomalies occur, or an emergency situation, the control system will be able to safely shut down individual turbines.

<u>Frequency and Duration of Planned Maintenance Activities</u>

It is likely that vessels involved in maintenance activities will be present in the AfL area throughout the year. On average this is expected to be one vessel per day. However, there may be periods when there are more vessels, e.g. two or three, or no vessels depending on weather conditions and extent / type of maintenance works required. The key maintenance activities, and their duration, are described below.

<u>Routine Inspections and Preventative (Minor) Maintenance</u>

Planned maintenance activities vary for the different turbine technologies. For some turbines it will be necessary to carry out regular inspections e.g. every two years using ROVs. Minor or preventative maintenance activities may also need to be carried out for some turbines every couple of years to replace consumable and short life components. Specific timescales for minor or preventative maintenance will be determined on a case by case basis depending on the turbine technology and whether maintenance is to be carried out at sea or onshore (quayside maintenance). For most turbines minor / preventative maintenance is expected to be completed within seven days (onshore or at sea). Routine ROV inspections are expected to take approximately 20 minutes per turbine.

<u>Maintenance</u>

Maintenance will be required for all turbines. It is likely that this will need to be undertaken every 5 to 10 years depending on the turbine technology and tidal conditions in the AfL area. Maintenance could involve a planned complete overhaul of the turbines, which would require the removal of the turbine from the sea, or detailed inspections with the replacement of key components where necessary.

For most turbines all maintenance activities will take place onshore (e.g. turbines will be removed from the water). For other turbines it may be possible to carry out some maintenance at sea (turbines will remain in-situ), subject to suitable weather and tide conditions. These turbines would only be recovered from the sea for maintenance onshore in the event of a turbine failure. Where maintenance is to be carried out at sea all works will be undertaken at slack tide and in reasonable sea states (wave height <2 m).

Planned major maintenance activities are likely to take longer e.g. turbines could be removed from the water for up to 30 days per turbine depending on the work required and whether all replacement parts are available at the time of the maintenance.

In addition to planned maintenance of the turbines, regular inspections of the export cables using drop down cameras and inspection class ROVs will also be required.

Vessels and Equipment Required for Inspections
Inspections of turbines and cables will be carried out using ROVs deployed from offshore small (25 – 30m) work class DP tugs or similar vessels. RIBs and dive boats may also be required.

Vessels and Equipment Required for Maintenance (Minor and Major)
Minor or preventative maintenance carried out at sea will involve the use of small (25 – 30m) work class tug or similar vessel, work class ROV and RIB.

Where turbines need to be removed from the sea for maintenance, this will require the use of large DP heavy lift crane vessels or purpose built twin hulled deployment barge developed specifically for the installation and removal of the OCT units (turbines and turbine support structures assembled onshore). Other support vessels will also be required including small DP vessel, crew transfer vessel (large 11m cabin RIB) and a dive vessel (6 – 7m RIB).

Unplanned Maintenance
All turbines will be fitted with on-board monitoring systems to check turbine performance and identify any damage, anomalies or faults. Turbines will be designed to shut down safely in the case of severe faults or damage. Any requirement for unplanned maintenance will be detected at early stage through monitoring systems on the turbines. Depending on weather conditions, and extent of the damage or fault it should be possible for unplanned maintenance to be performed in a reasonable time frame.

4.5.3 Decommissioning

It is the intention of BTAL to re-power all Projects at the end of the consent period. However, this would only be carried out with full agreement from all relevant parties and once the necessary consents are in place.

The decommissioning process is the reverse of the installation procedure and requires the same plant and machinery. Removed turbines would be disposed of in line with all local regulations and any parts and materials which could be salvaged would be recycled. Monopile and pinpile foundations will be cut off at the seabed.

Where the installation is to be repowered the export cables would be left in situ.

The impacts associated with decommissioning will be the same or less than those identified for installation. Decommissioning the site will be in accordance with requirements for decommissioning Offshore Renewable Energy Installations set out in the Energy Act 2004 (DECC, 2011) and requirements of the Crown Estate AfL which requires decommissioning to be completed within 24 months.

4.5.4 Summary of Vessel Requirements

A summary of the estimated vessel requirements is given in Table 4.2.

Table 4.2 Project Vessel Requirements

Activity	Vessel	Time Present in AfL Area
Installation of turbine support structures Installation of turbines	Selection of: • DP construction vessel with 250 to 400 tonne crane lift capacity plus DP construction vessel with 150 tonne crane lift capacity; • Purpose built twin hulled three point heavy lift barge; and / or • Jack-up barge / moored barge depending on site conditions and selected turbine support structure. Support vessels: small DP vessels with ROV on board, crew transfer vessels (RIBS), dive vessels (RIBS), tug boats.	Phase 1: 2019 – 2020 Phase 2: 2021 - 2023
Installation of cables	Specialised cable installation vessel.	Phase 1: Early 2019 Phase 2: 2020/2021
Installation of cable protection & stability measures	Specialised vessels comprising one of: • Vessel with fall pipe (rock placement); and / or • Heavy lift crane vessel for concrete mattresses and grout bags; • Inspection class ROVs.	Phase 1: 2019 Phase 2: 2020/2021

Activity	Vessel	Time Present in AfL Area
Landfall activities	Jack-up barge for sea to shore HDD.	Phase 1: 2019 Phase 2: 2020/2021
Routine inspections	Offshore small (25 – 30m) work class DP tug or similar with ROV on board. RIBS and dive boats may also be required.	Ongoing
Preventative maintenance	Small (25 – 30 m) work class tug or similar vessel, work class ROV and RIB.	Ongoing
General maintenance	Large DP crane vessels or purpose built twin hulled three point heavy lift deployment barge for installation of OCT with turbine support structure as single unit. Other support vessels including small DP vessel, crew transfer vessel and dive boats.	Every five years for each turbine – ongoing for Project life

5. EXISTING ENVIRONMENT

5.1 Introduction

This section presents the existing environment baseline information relating to navigation in the vicinity of the Brims AfL area.

The following baseline features are reviewed:

- Navigational Features
- Ports, Harbour Limits & Recommended Tracks
- IMO Routeing Measures
- Wrecks
- Oil and Gas Infrastructure
- Offshore Wind
- Dredging
- Cables and Pipelines
- Exercise Areas
- MEHRAs
- Other Navigational Features
- Sailing Directions

5.2 Navigational Features

The principal navigational features relative to the Brims AfL area are presented in Figure 5.1. This figure displays charted anchorage areas and navigational aids. The buoy and anchorage positions are taken from Admiralty Charts of the area, with supplementary information from Admiralty Sailing Directions and Clyde Cruising Club Sailing Directions and Anchorages.

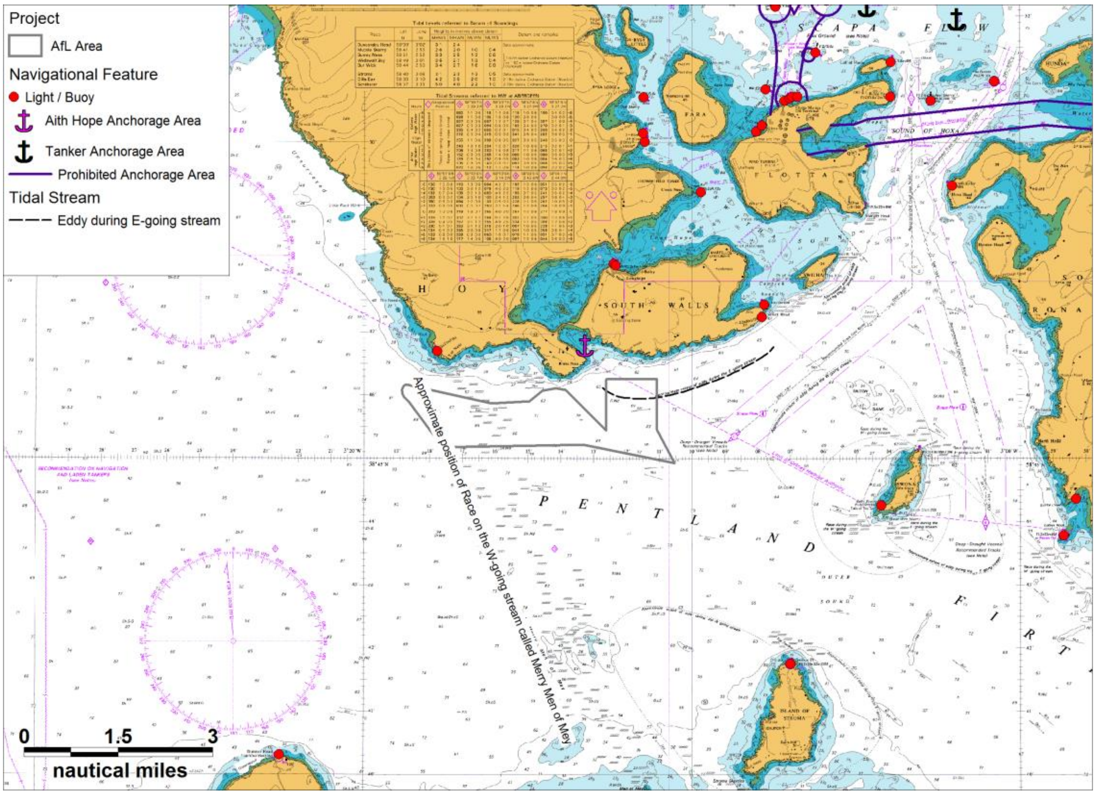


Figure 5.1 Navigational Features in the vicinity of the AfL area

A number of prohibited anchorage areas exist in Scapa Flow, to the north of the AfL area, to protect pipelines and structures associated with the Flotta Oil Terminal, and a military wreck.

In addition to charted anchorages, Aith Hope, 0.5nm north of the AfL area is noted in Clyde Cruising Club Sailing Directions and Anchorages (Clyde Cruising Club Publications, 2010) as an excellent anchorage if adverse conditions occur either from wind, tide or visibility.

Tidal streams, with eddies and turbulence, run strongly through the Pentland Firth and in the approaches to Scapa Flow. There is an eddy depicted within the northeastern extent of the AfL area which occurs during the east-going stream. The Merry Men of Mey, which runs during the west-going stream, runs through the western extent of the AfL area.

5.3 Ports, Harbour Limits and Recommended Tracks

OIC Marine Services administers 29 Orkney Harbour Areas for which it is the Competent Harbour Authority. The Council exercises its jurisdiction through a Director of Marine Services. The AfL area is in proximity to the Limit of Orkney Harbours and the north eastern part of the AfL area (approximately 0.08nm^2) lies within it, as presented in Figure 5.2. Following receipt of feedback from Orkney Harbours, BTAL confirmed that no deployment of turbines will occur within the Limit of Orkney Harbours. However, if cable corridor option 1 is developed there will be export cables passing through this area.

Within 5nm of the AfL area there are four ports; Longhope and Lyness Pier on Hoy, and Sutherland Pier and Gibraltar Pier on Flotta. The local ferry berths overnight at Longhope Pier and the lifeboat is stationed on its own berthing pontoon. Sutherland Pier is used mainly by the tugs and workboats that serve the Flotta Oil Terminal. Lyness Pier recently underwent redevelopment of the quays and shore side facilities to enable it to be used as a hub for the assembly and maintenance of renewable energy devices.

Marine Services operates a Vessel Traffic Service (VTS) from the Harbour Authority Building at Scapa. They presently have three radar sites:

- Sandy Hill covering Scapa Flow and the Pentland Firth
- Scapa covering the body of Scapa Flow
- Kirkwall covering Kirkwall Harbour and approaches

The VTS technology was upgraded during 2011-12 and further radar scanners are planned to be added. However, the existing scanner at Sandy Hill provides good coverage of the Brims area.

Pilotage is compulsory within the Competent Harbour Authority areas for passenger vessels over 65m in length, all other vessels over 80m overall length, all vessels under tow where the combined overall length of the towing vessel and the vessel being towed is over 65m, all vessels over 300 GRT carrying persistent oils in bulk.

Approximately 0.9nm east of the AfL area are recommended tracks for deep-draught vessels. The channels and deep-water tracks between the Pentland Firth and Scapa Flow are those recommended by the Orkney Harbours Navigation Service for tankers under pilotage proceeding to or from the Flotta Oil Terminal. The AfL area has been aligned such that any tanker approaching or exiting the recommended track (or its charted boundaries) and following a constant course before and after, will pass clear of the site. However, it is noted on the chart that, due to possible tidal effects, vessels may need to steer noticeably different courses from those shown in order to maintain the recommended tracks. Radar surveillance of these channels is continuously maintained by VTS.

It has been decided by BTAL that no deployment of turbines or substations will occur within the Limit of Orkney Harbours. However, if cable corridor option 1 is developed there will be export cables passing through this area.

Figure 5.2 presents a plot of these features.

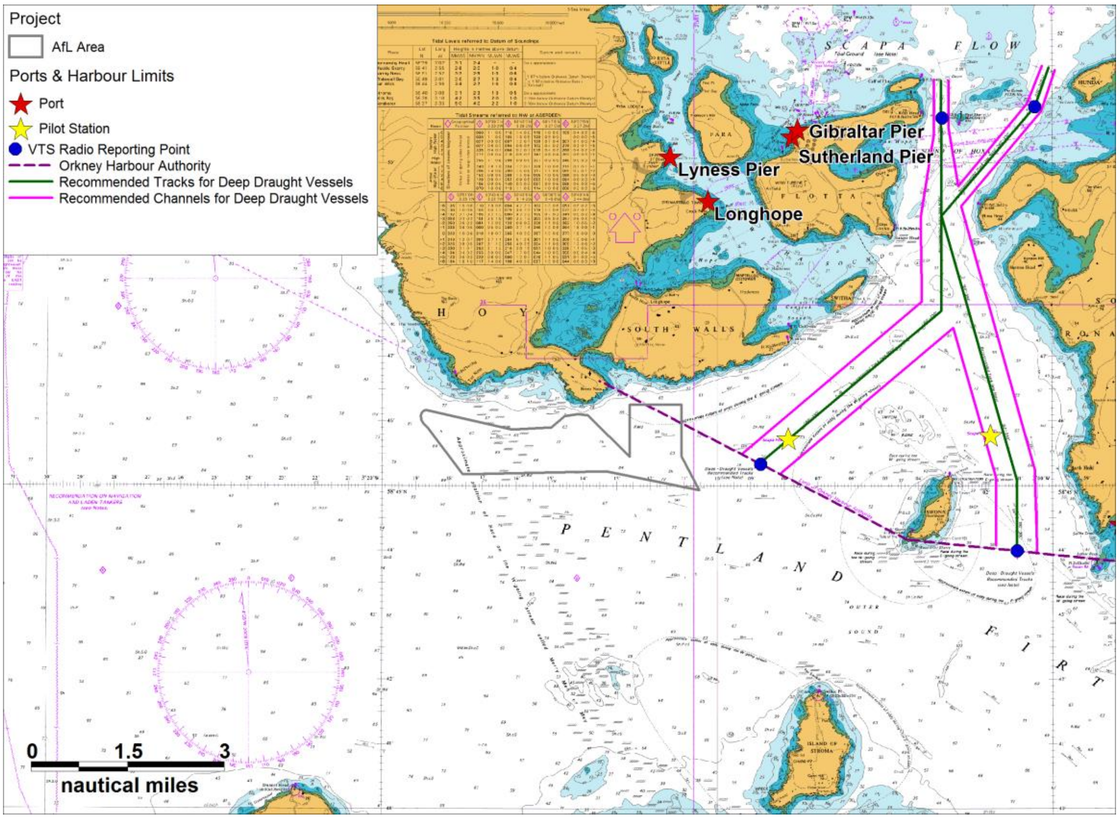


Figure 5.2 Ports & Harbour Limits in the vicinity of the AfL Area

5.4 IMO Routeing Measures

The Brims AfL area lies just to the south of the IMO-adopted Area to be Avoided (ATBA) which surrounds most of Orkney (excluding the Pentland Firth and Scapa Flow). The ATBA was established to protect the sensitive coastline following the *Braer* incident. To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other hazardous cargoes in bulk, should avoid this area.

Figure 5.3 presents the location of the Area to be Avoided in relation to the AfL area.

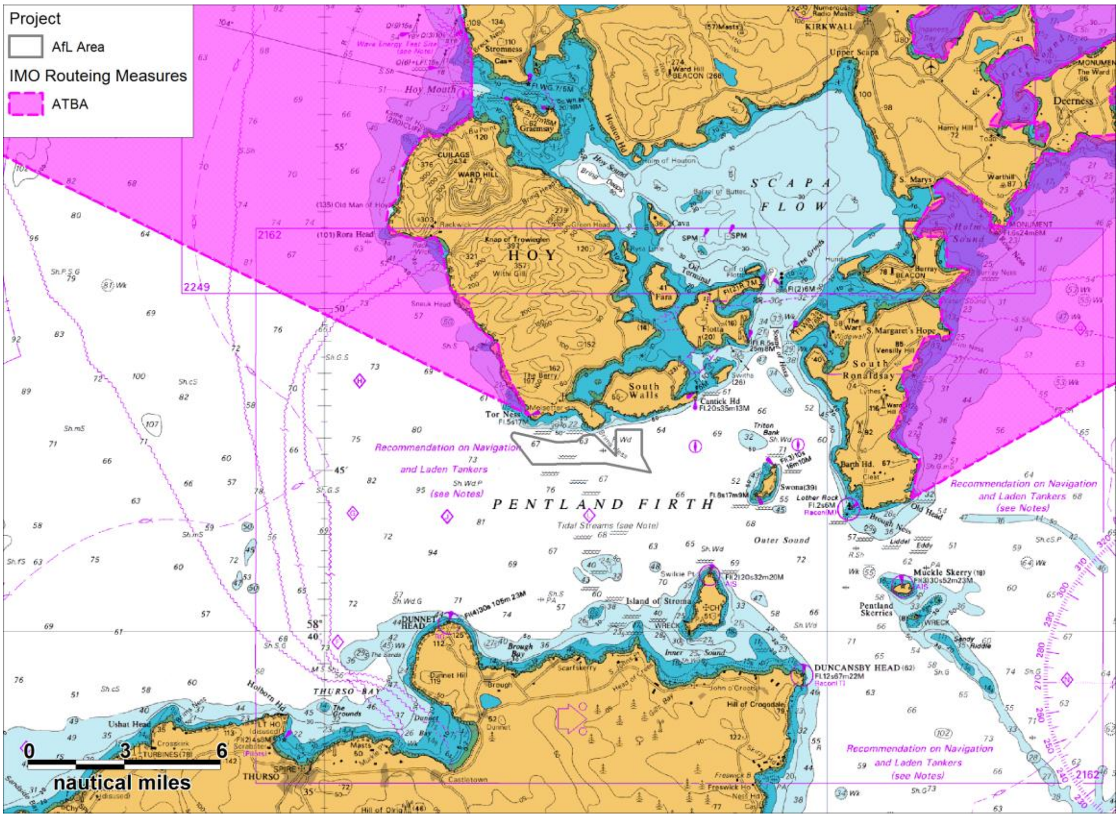


Figure 5.3 ATBA in the vicinity of the AfL Area

Chart notes advise that laden tankers not bound to or from Flotta and Scapa Flow should not use the Pentland Firth in restricted visibility or adverse weather. At other times there may be a case for transiting with the tide to reduce the time spent in the Firth, although they should be aware of very strong tidal streams and sets within the area. Difficulties can be encountered when transiting either with or against the tide. Masters should ensure that a close watch is kept at all times on the course, speed and position of vessels.

5.5 Wrecks

There are no charted wrecks in the immediate vicinity of the AfL area, however a number are present in Scapa Flow, to the north of the Project, which is popular for recreational diving. The closest charted wreck is within Kirk Hope, 3.2nm (by sea) northeast of the AfL area. Further details are presented in the Marine Archaeology chapter of the ES.

5.6 Oil and Gas Infrastructure

There are no oil and gas installations or licence blocks in the immediate vicinity of the Brims AfL area, however there are installations to the north of the Project, in Scapa Flow, associated with Flotta Oil Terminal, which is approximately 7nm north-northeast (by sea) of the AfL area. Installations here include a tank farm, pumping station, power station and burn-off flare.

5.7 Offshore Wind

There are no existing or planned offshore wind farm projects in the vicinity of the AfL area.

5.8 Dredging

There are no aggregates dredging areas in the vicinity of the Brims AfL area.

5.9 Cables and Pipelines

Subsea cables and pipelines in the region of the AfL area are presented in Figure 5.4.

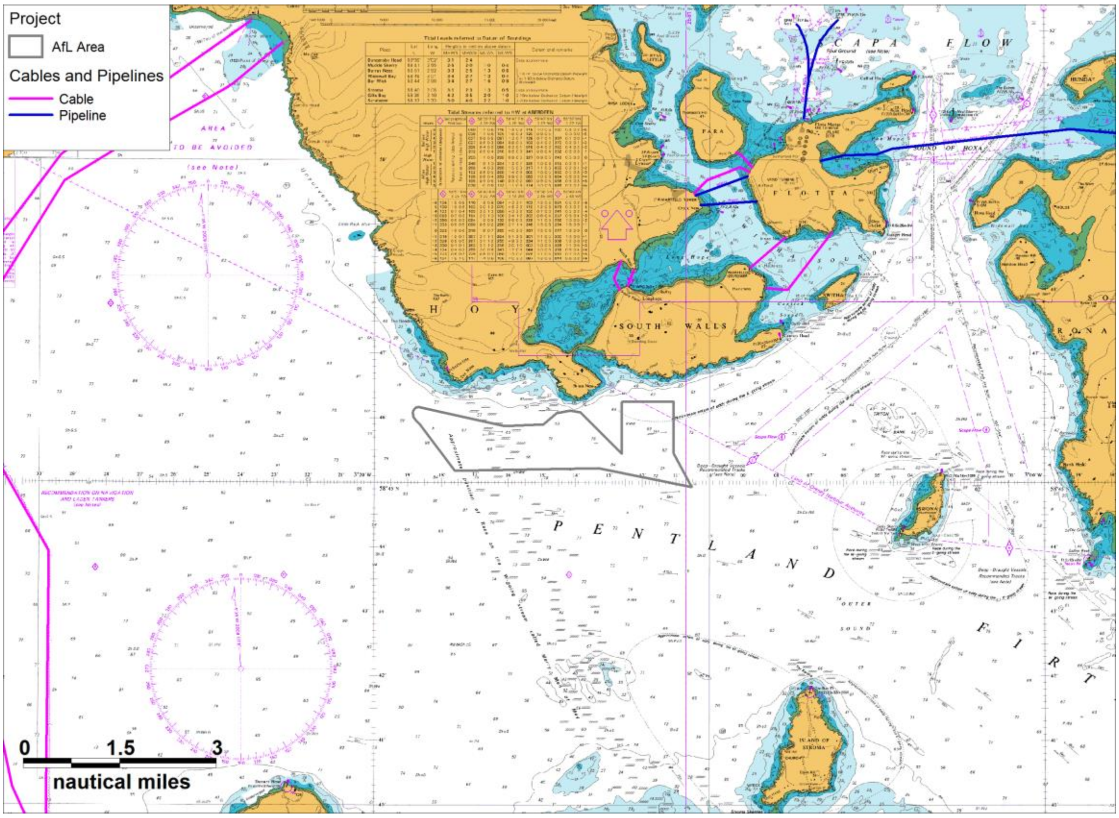


Figure 5.4 Cables and Pipelines in the vicinity of the AfL Area

A submarine cable area lies northeast of the AfL area, between the islands of South Walls and Flotta. Mariners are advised not to anchor or trawl in the vicinity of submarine cables. This area also contains foul in the form of wire hawsers. Several cables run west of the AfL area, from Hoy to Mainland Scotland.

There are two water pipelines northeast of the AfL area, spanning between Hoy and Flotta. An oil pipeline crosses the Sound of Hoxa. There are oil pipelines in Scapa Flow. Mariners are also advised against anchoring and trawling in the vicinity of pipelines.

5.10 Exercise Areas

There are no military practice areas in use by the Ministry of Defence (MoD) in the vicinity of the AfL area.

5.11 Marine Environmental High Risk Areas (MEHRAs)

Tor Ness on Hoy, approximately 0.5nm north of the AfL area, has been identified as a Marine Environmental High Risk Area (MEHRA) by the UK Government, i.e., an area of environmental sensitivity and at high risk of pollution from ships. The Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

Tor Ness has underlying statutory designations on wildlife, landscape and geological grounds, a very high concentration of vulnerable seabirds and a high level of offshore fishing activity. Figure 5.5 shows the Tor Ness MEHRA in relation to the Brims AfL area.

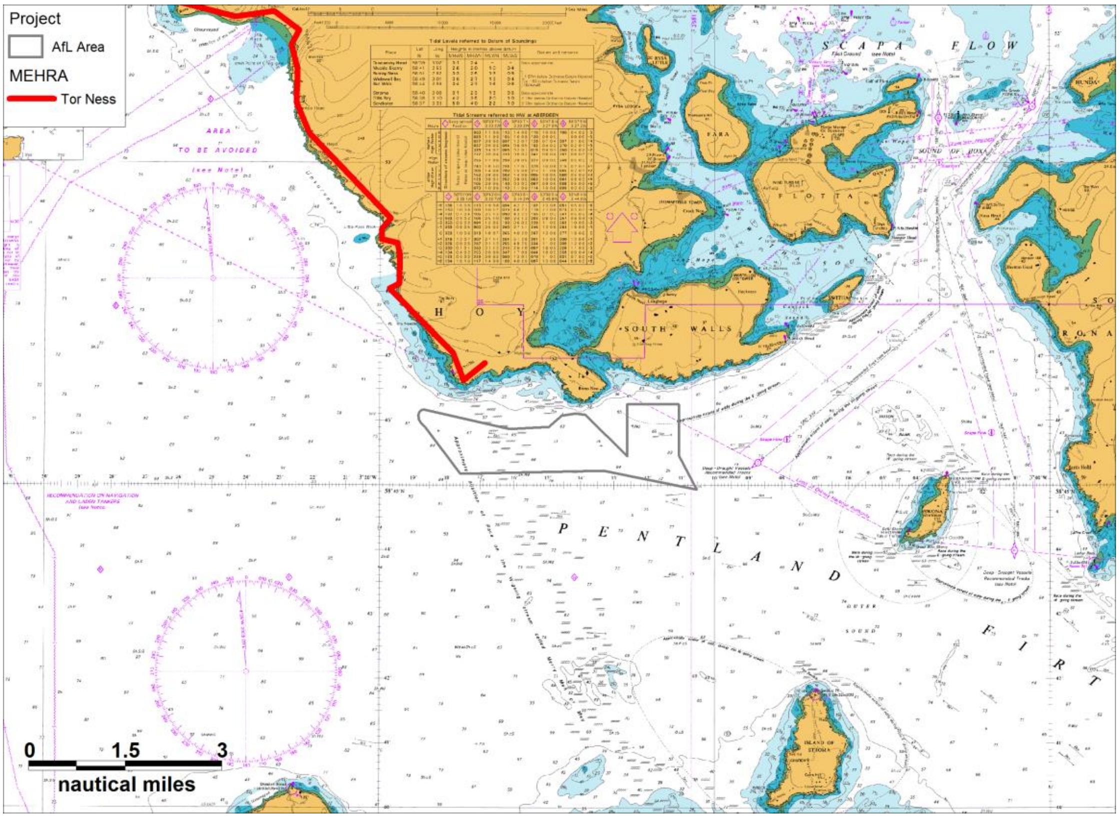


Figure 5.5 MEHRAs in the vicinity of the AfL Area

5.12 Other Navigational Features

Figure 5.6 presents other navigational features in the vicinity of the AfL area.

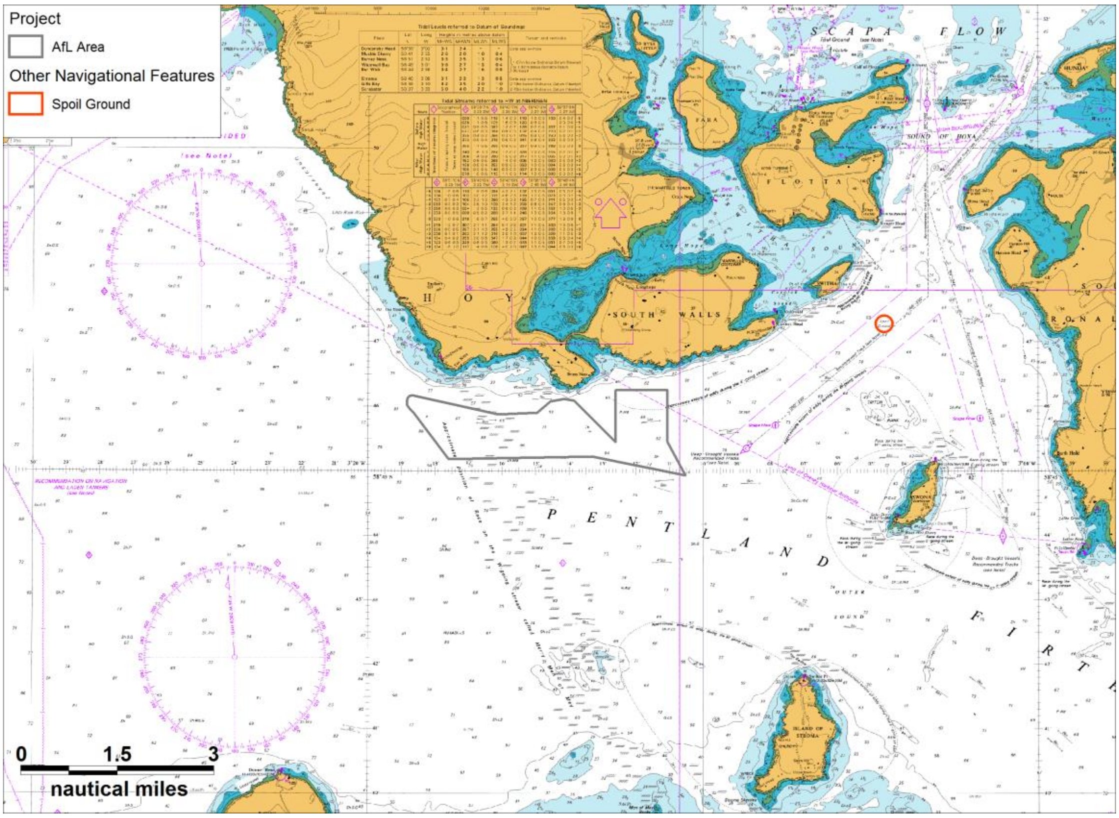


Figure 5.6 Other Navigational Features in the vicinity of the AfL area

There is an area of spoil ground 3.4nm east of the AfL area, within the recommended track for deep-draughted vessels.

5.13 Sailing Directions

Admiralty Sailing Directions for the area are presented in the North Coast of Scotland Pilot (UKHO, 2009). A description of the route in the vicinity of the AfL area, passing south of Hoy and west of Swona, is presented below.

5.13.1 Approach by Passage west of Swona

From a position about 1nm north of Dunnet Head, the track leads east-northeast to the pilot boarding position, passing south-southeast of Tor Ness, then south-southeast of Brims Ness. From the vicinity of the pilot boarding position 1.5nm south of Cantick Head, the recommended track to the south end of Sound of Hoxa leads northeast then north, passing northwest of Swona, then southeast of Cantick Head, and southeast of Switha.

Vessels approaching the channel west of Swona from southeast should pass 1.5nm east of Duncansby Head, whence the track leads northwest, passing mid-way between Swona and Stroma. Vessels approaching the east-going tidal stream should maintain this track until at least 1.5nm west Swona. Course may then be adjusted towards the pilot boarding position.

6. METOCEAN DATA

6.1 Introduction

This section presents metocean statistics for the area which have been used as input to the risk assessment.

According to the Admiralty Sailing Directions (UKHO, 2009), the area in the vicinity of the Project experiences a mild maritime climate due to the prevailing SW winds and the warming influence of the North Atlantic Current. Gale to hurricane force winds may occur from any direction especially during the period October to April.

Frequent mobile depressions affect the area, especially in winter, and widespread rain and low cloud is common.

Squally showers with winds between NW and NE are often accompanied by snow in winter. With N winds visibility is frequently good to very good, except in showers. Sea fog is uncommon in winter but increases in frequency during the summer months. Land fog is most frequent in autumn and winter around dawn and occasionally extends to inshore waters.

6.2 Wind and Wave Data

Significant wave height data (Hs) recorded at the Brims site at 0.5m intervals is shown in Figure 6.1. The statistics were derived from all the available AWAC data deployed at Brims Ness between the 14th November 2010 and 27th July 2012. Each instrument was deployed for approx. 30 days in different months at eight different sites. The highest recorded wave height during the survey was approximately 5.1m.

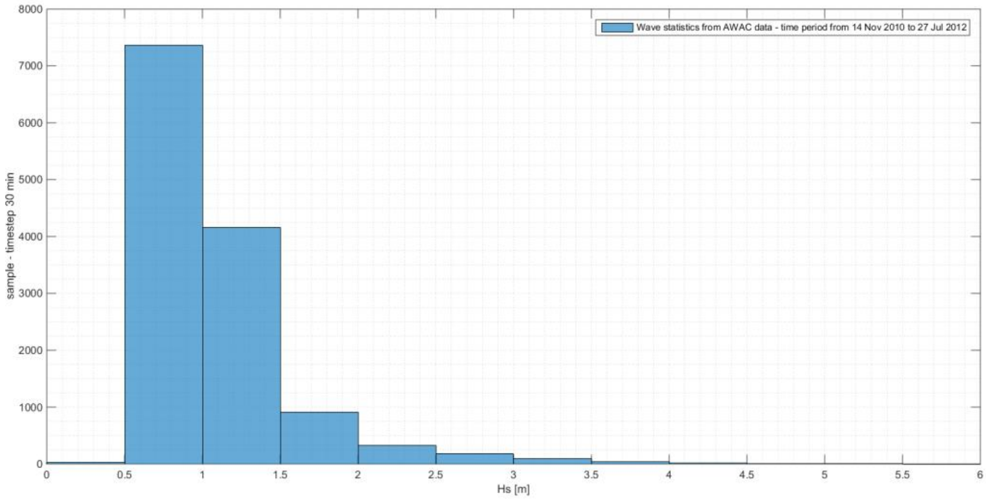


Figure 6.1 Wave Height Probability of Occurrence Directional Diagram

Long term wave data were not available and the temporal span of the available datasets is too reduced to obtain a representative picture of the wave climate within the site. Therefore, longer term wind and wave data for the general area has been taken from a location approximately 50nm north west of Brims, which should be conservative as it is in a more exposed offshore region (HSE, 2001).

The mean wind direction distribution for the area is presented in Figure 6.2. It can be seen that the most likely wind direction is from the SW. The annual probability of Beaufort Force 8 (gale) and above is 4.3%, although this is much higher in winter (13% in January) than in summer (0.01% in July).

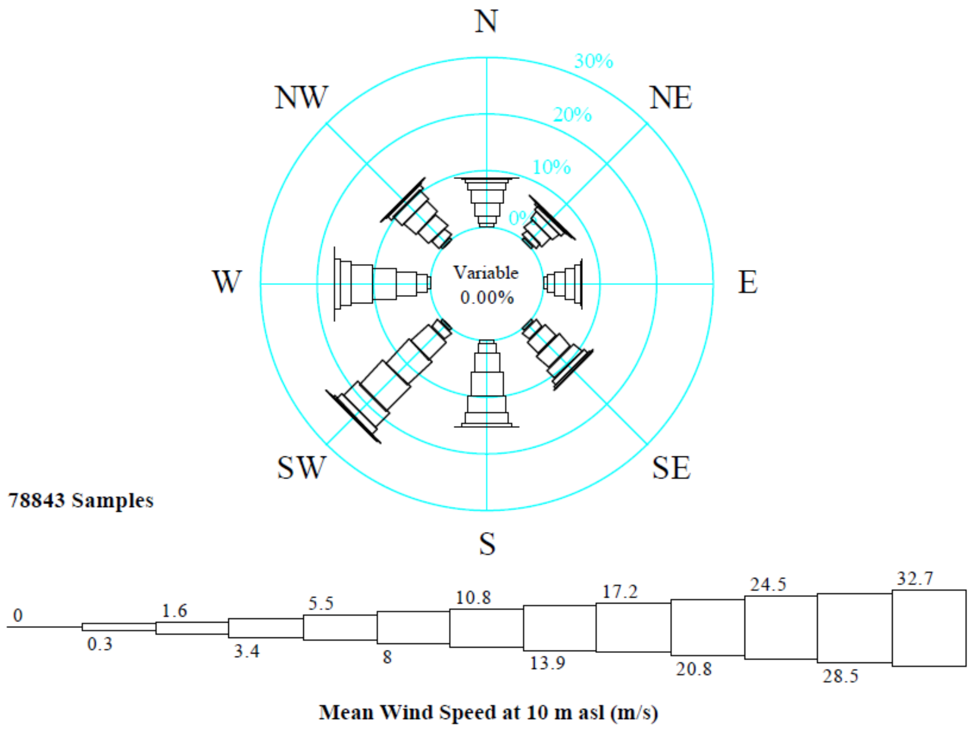


Figure 6.2 Mean Wind Rose for Location NW of Orkney

Wave data for the area is presented in Figure 6.3. The predominant wave direction is from the west.

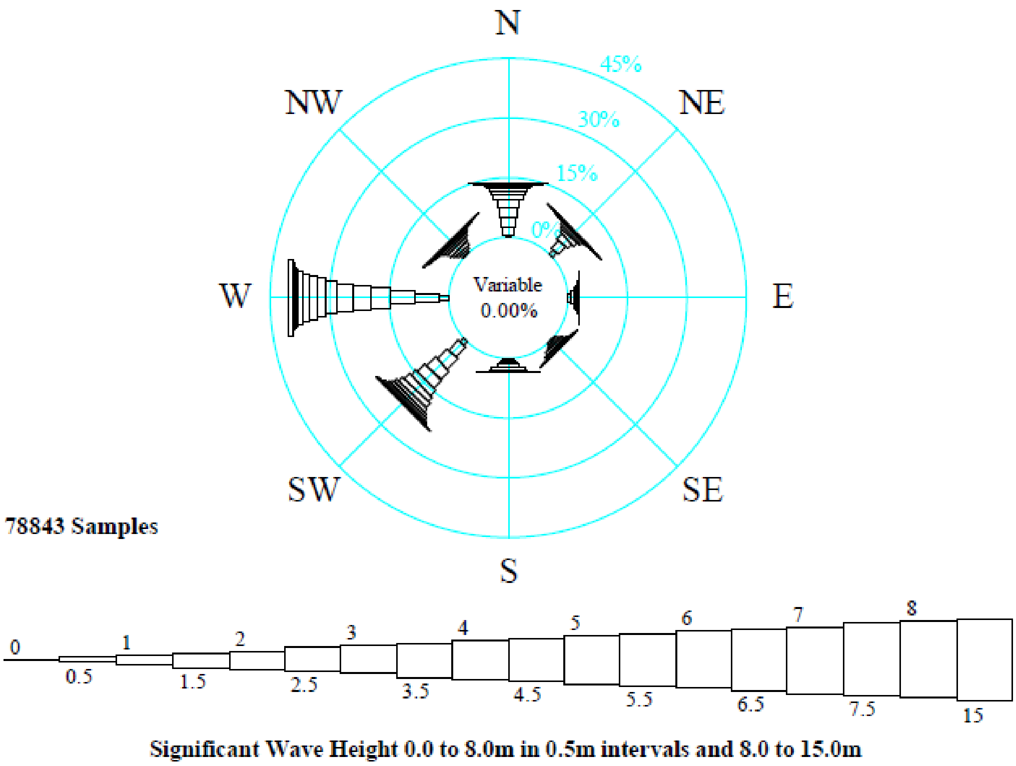


Figure 6.3 Significant Wave Height and Wave Direction for Location NW of Orkney

The significant wave height exceedence curve used as an input for the allision and collision risk modelling is presented in Figure 6.4.

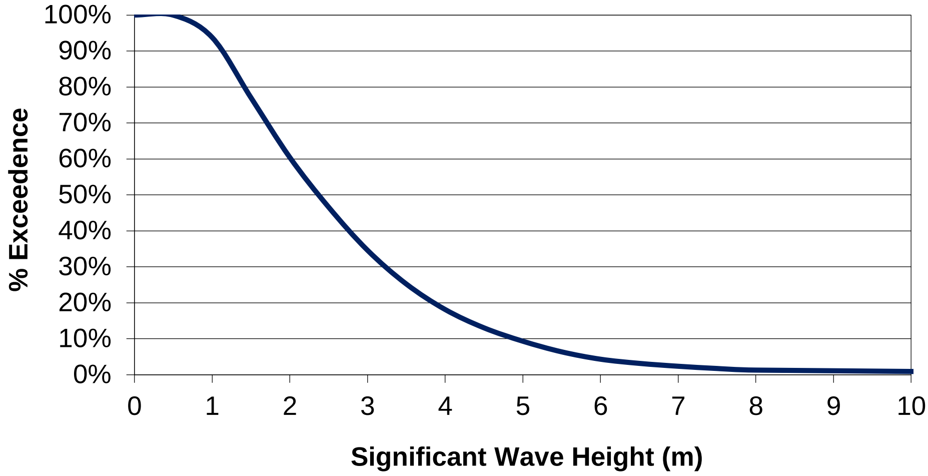


Figure 6.4 Significant Wave Height Exceedence Probability

The average annual significant wave height is 2.0-2.5m and the frequency of exceeding 5m is approximately 9.3%. This varies during the year with a probability of 26.7% in January compared to 0.00% in June and July. There is a 1.3% chance of H_s exceeding 8m.

6.3 Visibility

Historically, visibility has been shown to have a major influence on the risk of ship collision. According to the Admiralty Sailing Directions (UKHO, 2009), sea fog (visibility of less than 1km) is mainly encountered between April and September with warm moist air from the S. The percentage frequency of fog in June is around 4%. Visibility is frequently good over the open ocean.

Sea fog may occasionally affect coastal areas in summer with moist S winds. Between Pentland Firth and Rattray Head, the percentage frequency of visibility over 5 miles increases from about 83% in summer to around 90% in winter.

The average number of days with fog reported at Kirkwall (11 years of observations from 1995-2005), is provided in 45 per year. Therefore, in 12% of days annually, fog was recorded at Kirkwall although this may be for a short period only, not the full day.

6.4 Tide

A description of the tide in the general area of the north coast of Scotland is extracted from the Admiralty Sailing Directions (UKHO, 2009). The tide is predominantly semi-diurnal and progresses E along the N coast and through the Orkney and Shetland Islands thence S down the E coast.

The main in-going tidal stream sets along the N coast of Scotland and joins the S-going stream through the Shetland Islands and E of the Orkney Islands and thence S down the E coast. Among the islands tidal streams can be strong, particularly in the Pentland Firth, and eddies of considerable strength can be expected.

Tidal levels from Admiralty Chart 2162 (Pentland Firth and Approaches) for nearby Bur Wick and Scrabster, above Chart Datum, are presented in Table 6.1.

Table 6.1 Tidal Levels above LAT

Tidal Level	Height above Chart Datum	
	Bur Wick	Scrabster
Mean High Water Springs (MHWS)	3.4m	5.0m
Mean High Water Neaps (MHWN)	2.7m	4.0m
Mean Sea Level (MSL)	2.1m	3.0m
Mean Low Water Neaps (MLWN)	1.6m	2.1m
Mean Low Water Springs (MLWS)	0.8m	1.0m

Figure 6.5 presents the tidal diamond from Admiralty Chart 2162 in the vicinity of the Brims AfL area. Tidal diamond “G” lies approximately 1.5nm to the south of the AfL area boundary. The tidal stream runs generally east on the flood and west during ebb. The peak mean spring and neap tidal rates are 5.1 knots and 2.6 knots, respectively, both in the

direction 264 degrees and both occurring one hour after high water (where times are referring to high water at Aberdeen).

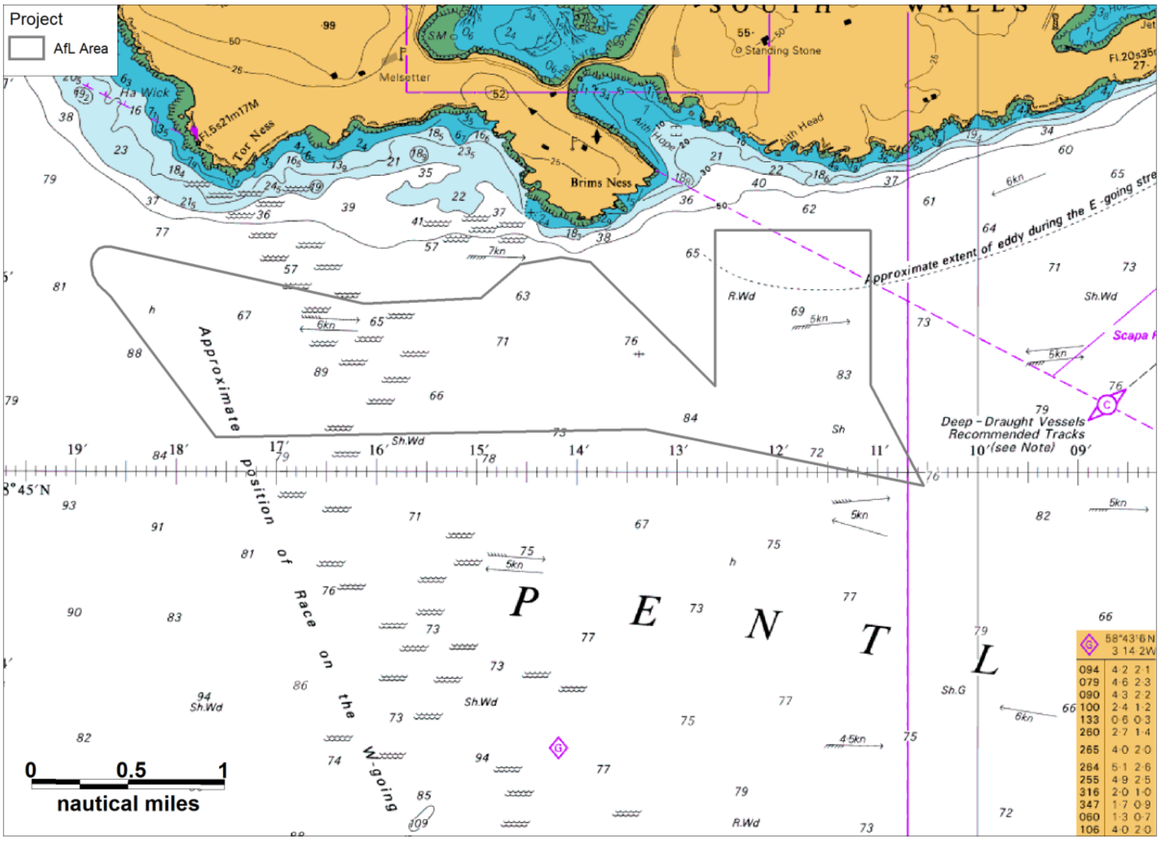


Figure 6.5 Nearest Charted Tidal Stream Data near Brims (Diamond "G")

Tidal height data for the site were extracted from a 19 year harmonic prediction (between 2003 and 2021) derived from the ADCP data. The data were provided for five sites within the AfL area. These give a good understanding of the tidal variations in the area of interest. The probability of different tidal heights above LAT in 0.5m intervals for the central of the five sites, located towards the south of the AfL area, is presented in Figure 6.6.

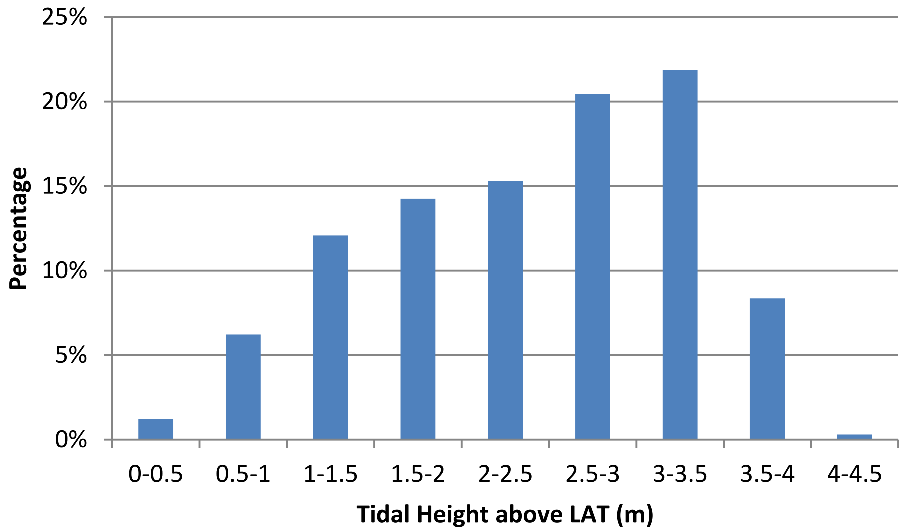


Figure 6.6 Tidal Height Data for Site 20 within AfL Area (58.75619 N, 3.256462 W)

The mean tidal height above LAT was assessed to be 2.4m and the maximum height was 4.2m. There is a 93% probability of at least 1m of water above LAT and 66% probability of at least 2m.

The data were similar for the other four sites within the AfL area, to the west and east.

7. EMERGENCY RESPONSE OVERVIEW AND ASSESSMENT

7.1 Introduction

The following sections identify current response capabilities delivered by the UK emergency response providers.

(A detailed review of the historical incidents in the area, including RNLI launches, is presented in Section 8).

7.2 MCA including HM Coastguard

At the time of writing, the HM Coastguard (HMCG), a division of the MCA, coordinates SAR through a network of 18 Maritime Rescue Coordination Centres (MRCC).

The Brims Tidal Array currently lies in the former Scotland and Northern Ireland Search and Rescue Region with the MRCC covering the proposed Brims AfL area being Shetland. MRCC Shetland area of responsibility covers the Shetland Islands, Fair Isle and Orkney Islands and mainland Scotland from Cape Wrath to South of Brora.

The MCA published a consultation document in December 2010 (MCA, 2010) in order to modernise HMCG. The main part of the document proposes the reduction in the number of MRCC stations around the UK coastline.

Revised plans were released by the UK Government, (MCA, 2011) mid-way through 2011 with a second consultation period from 14 July 2011 to 6 October 2011. Under the revised proposals the MCA intends to:

- Establish a single 24 hour Maritime Operations Centre (MOC) based in Segensworth, near Fareham in Hampshire, with 96 operational coastguards. The MOC will act as a national strategic centre to manage Coastguard operations across the entire UK network as well as co-ordinating incidents on a day to day basis. The MOC will also generate a maritime picture using information from a variety of sources;

- Dover will be configured to act as a stand-by MOC for contingency purposes. Dover would have 28 staff and would retain its responsibilities for the Channel Navigation Information Service (CNIS);

- In addition to the MOC and Dover, there will be eight further Maritime Rescue Sub Centres (MRSCs), all of which would be connected to the national network and the MOC. All would be open 24 hours a day with a total staffing of 23 in each. These would be based at the following stations:

    - MRSC Aberdeen
    - MRSC Shetland
    - MRSC Stornoway
    - MRSC Belfast
    - MRSC Holyhead

- MRSC Milford Haven
- MRSC Falmouth
- MRSC Humber

*NB: The station at London will be retained unchanged.

The location of the Shetland MRCC / MRSC in relation to the Brims AfL area is presented in Figure 7.1.

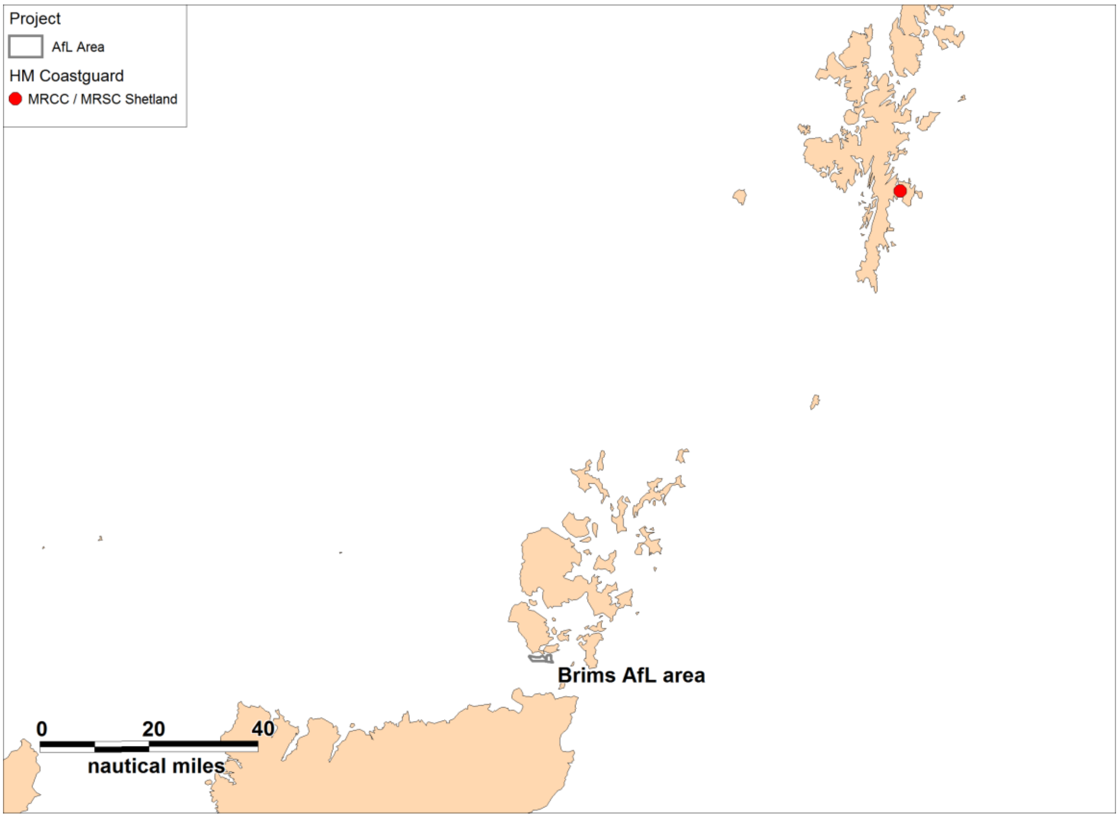


Figure 7.1 Shetland MRCC / MRSC relative to the AfL area

It is noted that the modernisation of the MCA and HMCG is not intended to be a reduction in emergency response facilities but an improved method of coordination and control. Therefore the MCA expects no impacts on the level of response provided in the area. As per MCA guidance, however, a level of self-help in addition to the national emergency response capability will be required at the Brims Tidal Array. This will be considered in more detail during the preparation of the ERCoP which is required to be approved by the MCA prior to construction commencing.

7.3 SAR Resources

7.3.1 SAR Helicopters

Figure 7.2 indicates that the closest SAR helicopter base is located at Inverness, 77nm south southwest of the AfL area, operated by the Bristow Group. This base has two Augusta Westland AW189 helicopters which have a maximum cruise speed of 145 knots and operational range in excess of 200nm radius of action. This will cover the Brims Tidal Array.

The base will be operational 24 hours a day, but details of readiness times are unknown. The response time from the base at Inverness to the Brims Tidal Array will be 32 minutes plus the readiness time.

In addition to this, the Sumburgh base is located 88nm northeast of the AfL area, also operated by Bristow. This base has two Sikorsky S92 helicopters which have a maximum cruise speed of 165 knots and operational range in excess of 250nm radius of action. This will also cover Brims Tidal Array.

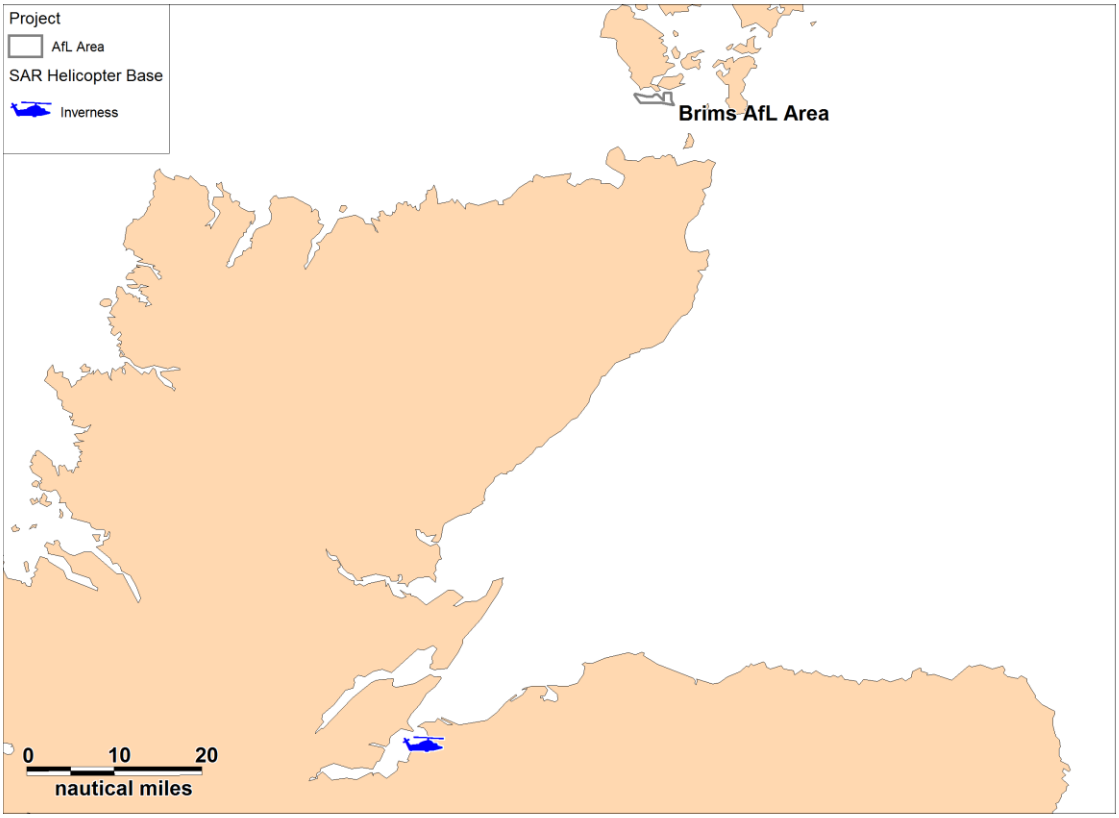


Figure 7.2 Inverness SAR helicopter base relative to the AfL area

7.3.2 Emergency Towing Vessels, Fires and Salvage

The MCA has one emergency towing vessel (ETV), *Herakles*, situated in Kirkwall. However, this is on a temporary contract and is planned to cease operation in March 2016.

The responsibility for dealing with fires on vessels lies with the vessel's operating company. The vessel's operating company is obligated to have a safety management system in place. HMCG will monitor any situation for risk to life or marine pollution. SAR assets will be tasked to assist if the fire has not been dealt with or commercial salvers tasked to assist in saving the vessel and cargo if required.

Private salvage companies may be tasked by the MCA for a variety of tasks including wreck removal, cargo recovery, towage and pollution defence. These private vessels are situated throughout UK waters and ports waiting to be tasked.

7.3.3 Coastguard Agreement on Salvage and Towage (CAST)

Where there is a serious risk of harm to persons or property, or a significant risk of pollution, it may be necessary to initiate emergency towing arrangements. The MCA has a framework agreement with the British Tugowners Association for emergency chartering arrangements for harbour tugs. The agreement covers activation, contractual arrangements, liabilities and operational procedures, should the MCA request assistance from any local harbour tug as part of the response to an incident. Modern harbour tugs are often capable of providing an effective emergency service in all but the worst weather conditions, and to the largest vessels. The UK towage industry has invested heavily over recent years in powerful omni-directional tugs typically of over 50 tonnes bollard pull and with fire-fighting capability. Where weather conditions or size of casualty restrict their use, such tugs can also perform a useful task in providing first response prior to the arrival of other more suitable vessels.

There are three tugs in Scapa Flow operated by Orkney Towage Company Ltd., which (subject to availability) could reach the site within 1-2 hours. These tugs have a bollard pull of 55 tonnes. Towage Services is signatory to the CAST agreement and therefore the MCA may call upon their services (subject to availability) to assist in salvage operations were a vessel is in danger of causing pollution, danger to other shipping or to assist in counter pollution duties.

7.3.4 Pollution Control and Clean-Up

Any incident of marine pollution or the possibility of pollution must be reported to the nearest MRCC station which will inform the duty counter pollution and salvage officer which determines the level of response - local, regional or national. A local response is a situation that can be dealt with by one authority not requiring assistance from any other authorities. Regional and national responses are required when a significant pollution spill occurs requiring a salvage operation, a spill that requires the deployment of vessels or aircraft to assist in dispersal or during a spill that the local authority does not have the capability to respond to adequately and requires assistance from the MCA.

The initial goal if possible is to prevent pollution, the second step is to stop any further pollution through containment and the third is to minimise environmental hazards.

The MCA may deploy air borne or sea borne equipment to disperse or neutralise the pollution if the installation or the vessel does not have the capability to do so. Commercial salvers can be tasked to perform suitable salvage operations with the goal of minimising pollution.

7.3.5 MCA Tiered Response for Pollution

For the purpose of planning, tiers are used to categorise oil pollution incidents. The tiered approach to oil pollution contingency planning identifies resources for responding to spills of increasing magnitude and complexity by extending the geographical area over which the response is coordinated:

- Tier 1 Local (within the capability of one local authority, harbour authority or development);
- Tier 2 Regional (beyond the capability of one local authority or development); and
- Tier 3 National (requires national resources).

7.3.6 Secretary of States' Representative for Salvage and Intervention (SOSREP)

The role of the SOSREP is to represent the Department for Transport (in relation to ships) and the Department of Energy and Climate Change (in relations to offshore installations) by removing or reducing the risk to safety, property and the UK environment arising from accidents involving ships, fixed or floating platforms or sub-sea infrastructure. SOSREP's powers extend to UK territorial waters (12 nautical miles from the coast/baseline) for safety issues and to the UK Pollution Control Zone (200 miles or the median line with neighbouring states) for pollution.

7.3.7 RNLI Lifeboats

The RNLI maintains a fleet of over 340 lifeboats of various types at approximately 236 stations around the coast of the UK and Ireland. The RNLI stations in the vicinity of the Brims Tidal Array are presented in Figure 7.3.

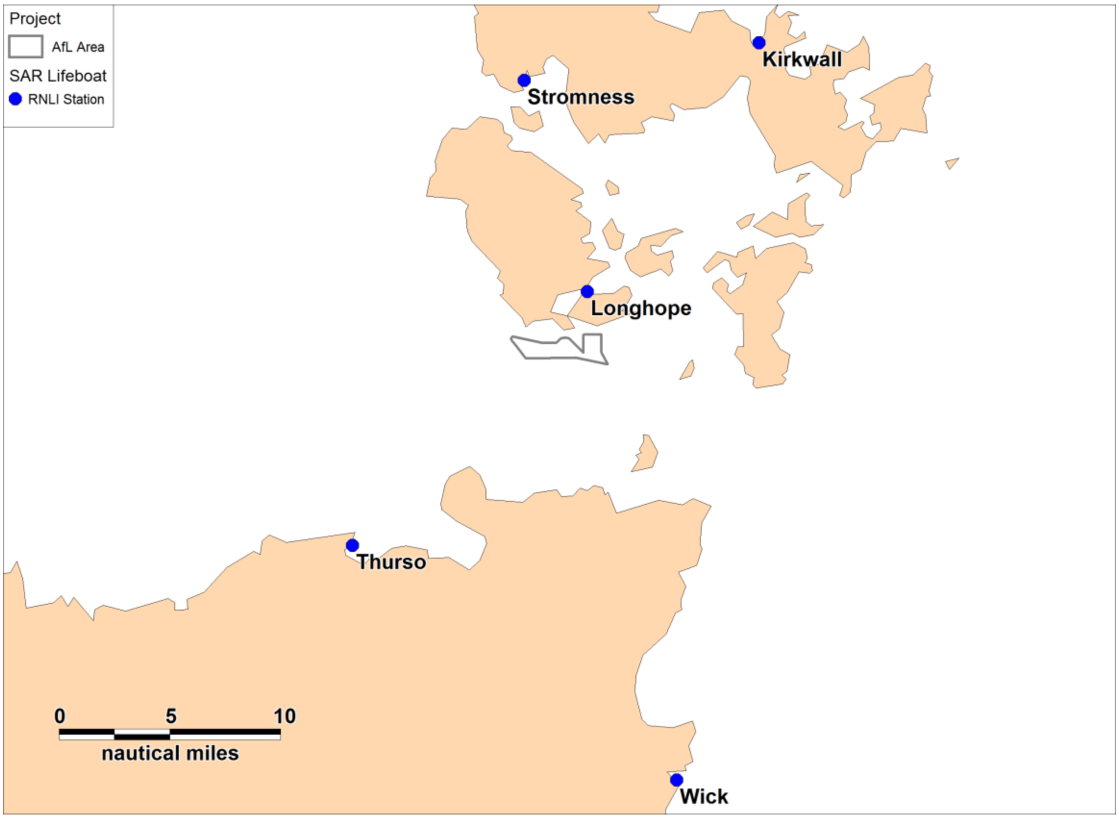


Figure 7.3 RNLI Bases in the vicinity of the AfL area

Table 7.1 provides a summary of the facilities at RNLI bases which are shown in the incident review in Section 8 to be the ones most likely to respond to an incident in the vicinity of the Brims Tidal Array. At each of these stations crew and lifeboats are available on a 24 hour basis throughout the year.

Table 7.1 Lifeboats at RNLI Stations in the vicinity of the Brims Tidal Array

Station	Lifeboat Type	Name	Approx. Distance to Project by Sea (nm)

Station	Lifeboat Type	Name	Approx. Distance to Project by Sea (nm)
Longhope	ALB	Helen Comrie	6.3
Thurso	ALB	The Taylors	11.7
Stromness	ALB	Violet, Dorothy & Kathleen	18

The nearest RNLI station relative to the Brims Tidal Array is Longhope, where a Tamar class all-weather lifeboat (ALB) is available. The lifeboat *Helen Comrie* is 16.3m in length and has a maximum speed of 25 knots. The average response time declared by the RNLI for an ALB is 14 minutes. This is the time from callout, i.e., first contact from the Coastguard to the lifeboat station, to launch of the lifeboat.

The time for an ALB from Longhope to reach the eastern boundary of the AfL area would be approximately 30 minutes (taking into account a 14 minute callout time).

7.4 Project SAR Matters

The Brims Tidal Array will meet the MCA's requirements (where applicable to tidal turbines) in terms of standards and procedures for shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around the site. These are laid out in Annex 5 of MGN 371 (MCA, 2008a).

The MCA will be consulted on the final layout to ensure it complies with SAR requirements. It will also be ensured that the emergency services are provided with all the details they need about the site in order to respond appropriately to any future incident in or near the area using SAR helicopter and/or lifeboat.

As part of this, an Emergency Response Co-operation Plan (ERCoP) for the Brims Tidal Array will be in place prior to construction being undertaken. An outline of the contents of an ERCoP based on guidance provided by the MCA is as follows:

- The Company – roles, responsibilities, contacts
- The Installation – layout, lat & longs, graphics, dimensions, spacing, export cable, emergency shutdown procedures, work operations, emergency comms, National SAR resources, Reporting Incident Position and Helicopter Offshore Routing
- The CGOC (Coastguard Operation Centre) – roles & responsibilities, contacts
- SAR Facilities and Response Capability – surface craft and airborne resources
- Medical Advice / Assistance
- Firefighting, Chemical hazards, Trapped Persons, etc.
- Survivors Shore Reception Arrangements
- Informing Next-of-Kin
- Suspension / Termination of SAR action
- Criminal Actions
- Media Relations
- Exercises – twice per year

- Unexploded Ordnance and Wreck Materials Located on or Near to OREIs
- Counter Pollution
- Wreck or Wreck Materials

8. MARITIME INCIDENTS

8.1 Introduction

This section reviews maritime incidents that have occurred in the vicinity of the Brims Tidal Array in recent years.

The analysis is intended to provide a general indication as to whether the area of the proposed development is currently a low or high risk area in terms of maritime incidents. If it was found to be a particular high risk area for incidents, this may indicate that the development could exacerbate the existing maritime safety risks in the area.

The most recently available 10 years of data from the following sources has been analysed:

- Marine Accident Investigation Branch (MAIB)
- Royal National Lifeboat Institution (RNLI)

(It is noted that the same incident may be recorded by both sources.)

8.2 MAIB

All UK-flagged commercial vessels are required to report accidents to MAIB. Non-UK flagged vessels do not have to report unless they are within a UK port / harbour or are within UK 12 mile territorial waters and carrying passengers to or from a UK port (including those in inland waterways). However, the MAIB will record details of significant accidents of which they are notified by bodies such as the Coastguard, or by monitoring news and other information sources for relevant accidents. The Maritime and Coastguard Agency, harbour authorities and inland waterway authorities also have a duty to report accidents to the MAIB.

The locations[1] of accidents, injuries and hazardous incidents reported to MAIB within 5nm of the AfL area between January 2004 and December 2013 are presented in Figure 8.1, thematically mapped by type.

[1] MAIB aim for 97% accuracy in reporting the locations of incidents.

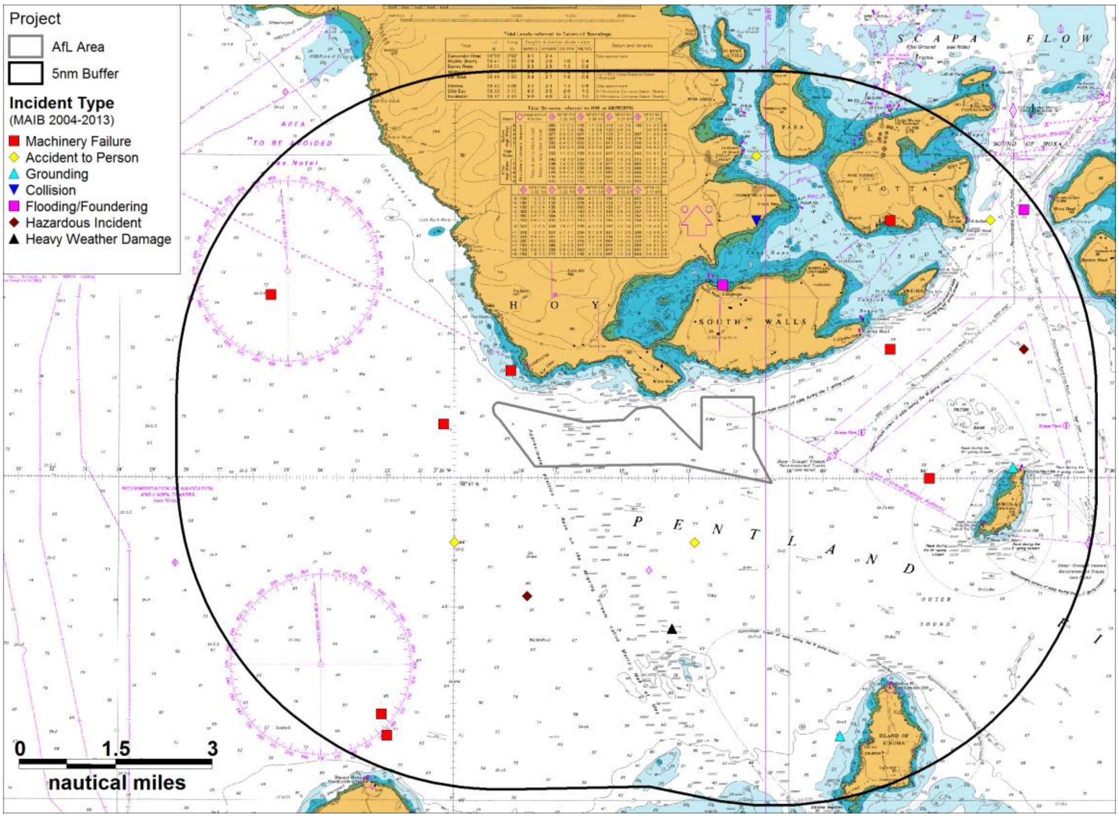


Figure 8.1 MAIB Incident Locations by Type within 5nm of AfL Area

A total of 23 unique incidents were recorded over the 10 year period, an average of just over two incidents per year.

The overall distribution by incident type, vessel type and year is presented in Figure 8.2, Figure 8.3 and Figure 8.4, respectively.

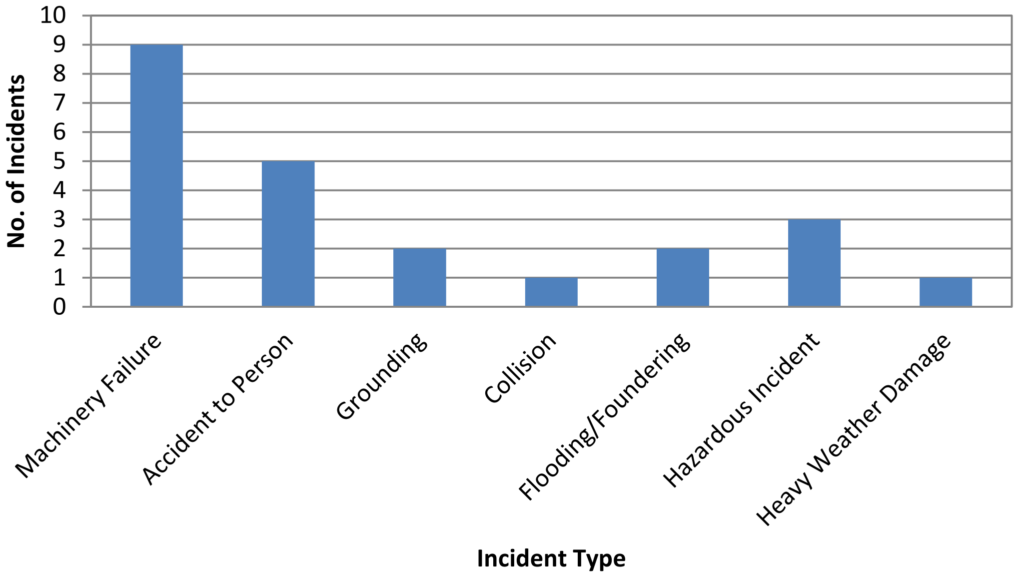


Figure 8.2 MAIB Incidents by Type within 5nm (2004-13)

The most common type of incidents were machinery failure (39%) followed by accident to person (22%).

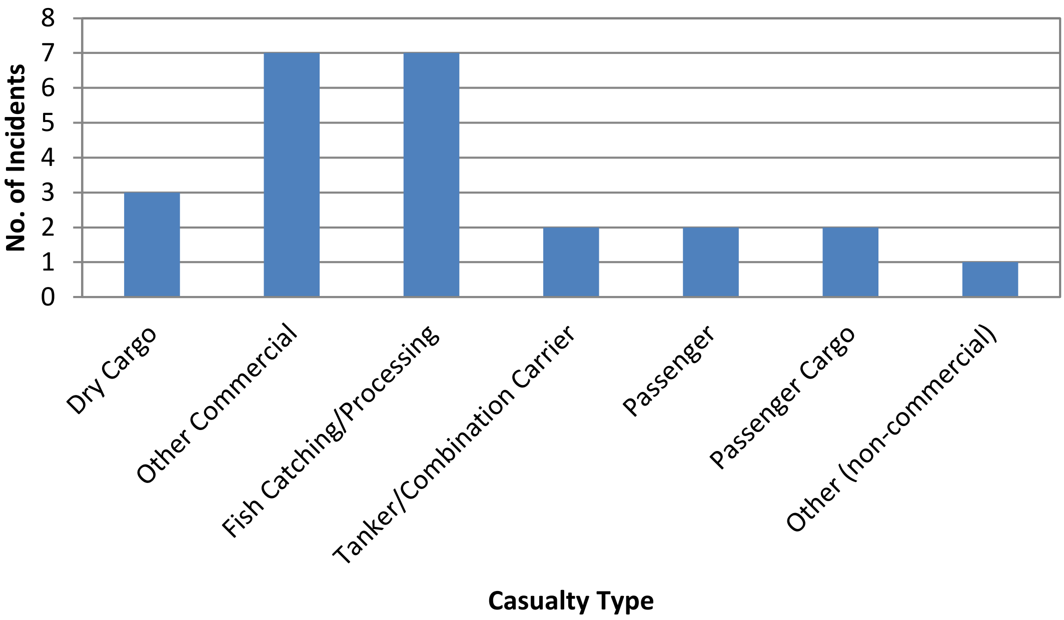


Figure 8.3 MAIB Incidents by Casualty Type within 5nm (2004-13)

Commercial motor vessels (29%) and fish catching / processing vessels (29%) were the most commonly involved in incidents, followed by dry cargo vessels (13%).

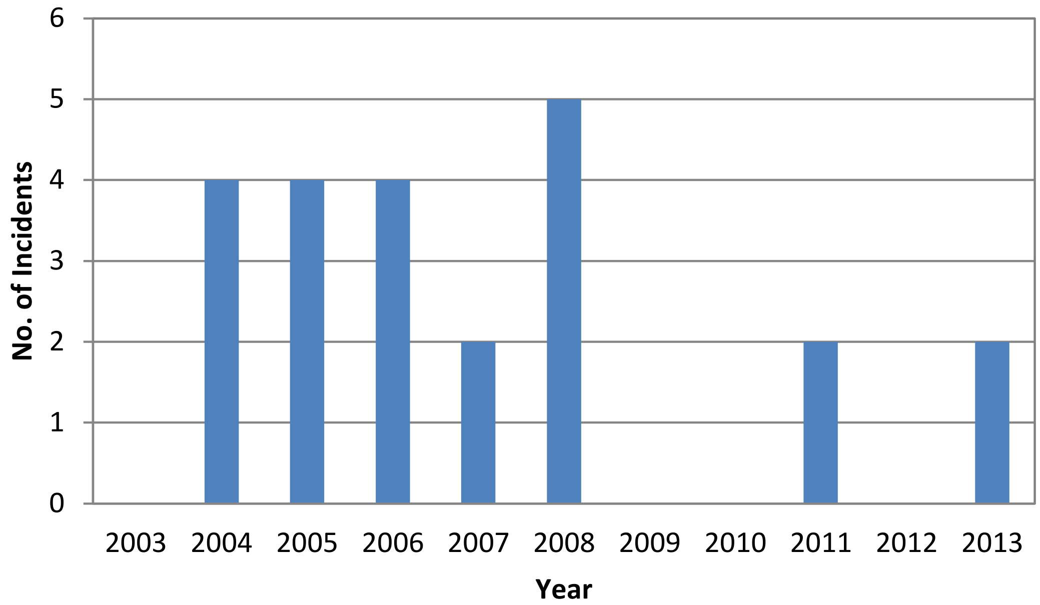


Figure 8.4 MAIB Incidents by Year within 5nm (2004-13)

In terms of yearly variations, it can be seen that the number of incidents fluctuated from none to five within the period analysed.

No MAIB incidents were reported within the AfL area over the 10 year period analysed. The two closest incidents to the AfL area were examined in greater detail, with all other incidents being over 1nm from the AfL area. The closest incident occurred approximately 0.5nm north. On 9 July 2006 a machinery failure occurred on a single handed potter. After recovering two fleets of 15 creels each, the engine stopped. This was caused by a failure in the diode in the engine fuel pump electrical circuit. The second closest incident occurred 0.8nm west of the AfL area on 7 April 2005 when a fishing vessel's gear became entangled in the vessel's propeller. The vessel was towed to sheltered waters by another fishing vessel, and to safety by a harbour tug.

8.3 RNLI

Data on RNLI lifeboat responses within 5nm of the AfL area in the ten-year period between 2001 and 2010 have been analysed (the most recent ten year period available).

A total of 29 launches, to 25 unique incidents, were recorded by the RNLI (excluding hoaxes and false alarms), i.e., an average of two to three per year, between 2001 and 2010.

Cross-referencing by date and location, seven of the RNLI incidents were also recorded in the MAIB data.

Figure 8.5 presents the geographical location of incidents thematically mapped by casualty type.)

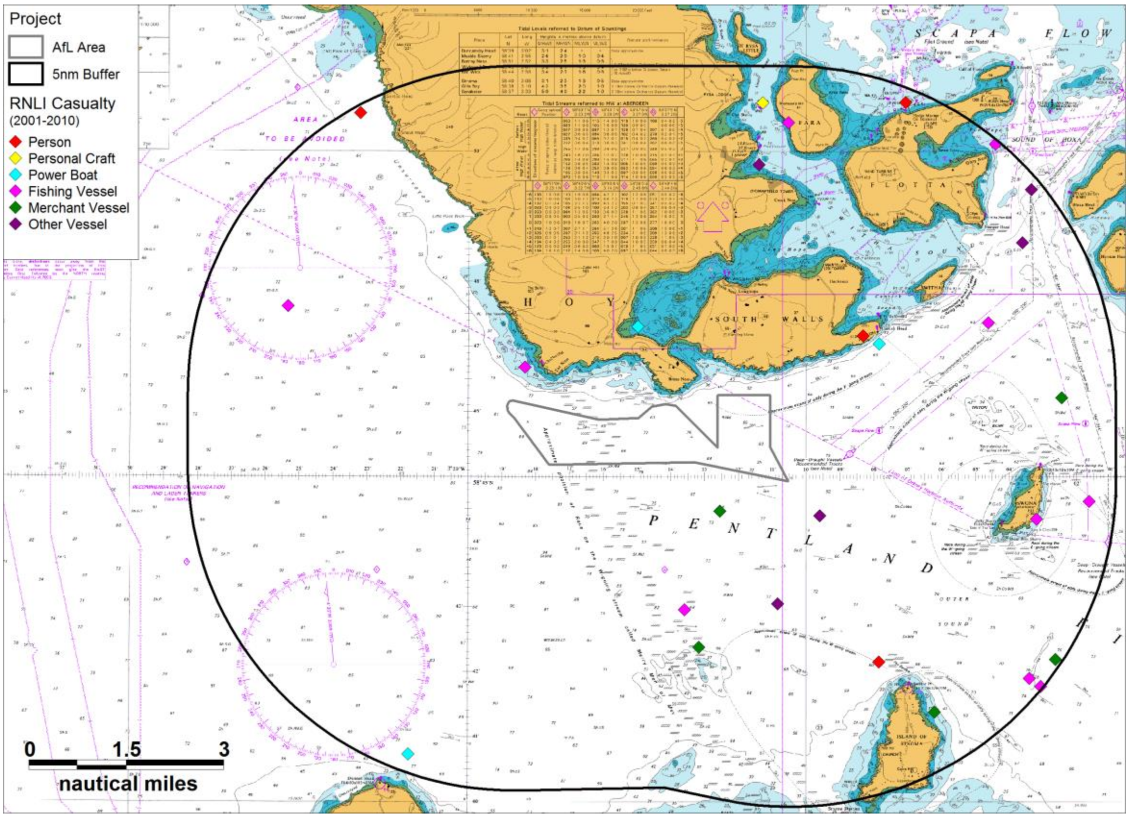


Figure 8.5 RNLI Incidents by Casualty Type within 5nm of AfL Area

The overall distribution by type of casualty is summarised in Figure 8.6.

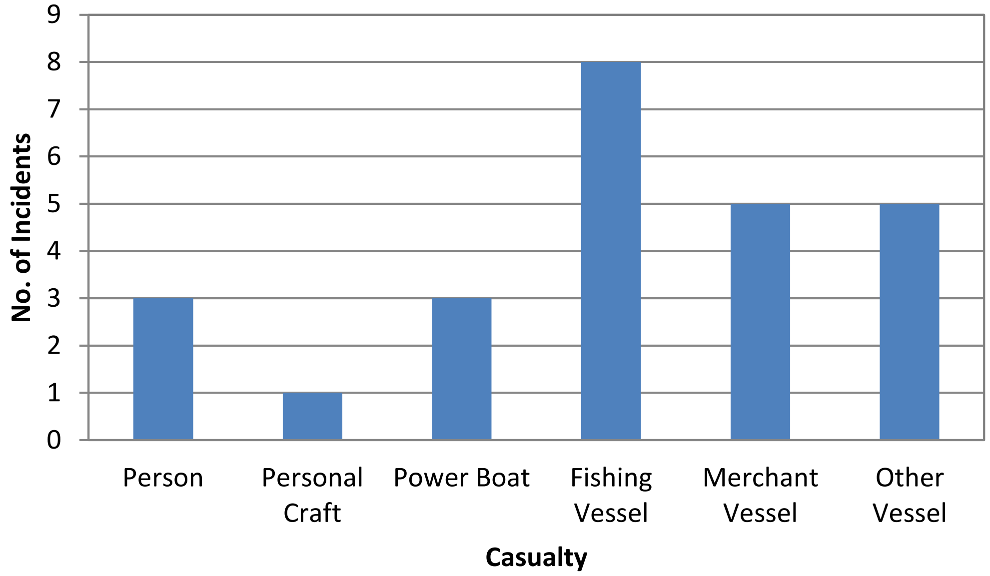


Figure 8.6 RNLI Incidents by Casualty Type within 5nm (2001-2010)

The most common casualty types involved were fishing vessel (32%), merchant vessel (20%) and 'other' vessel (20%).

A chart of the incidents thematically mapped by cause is presented in Figure 8.7.

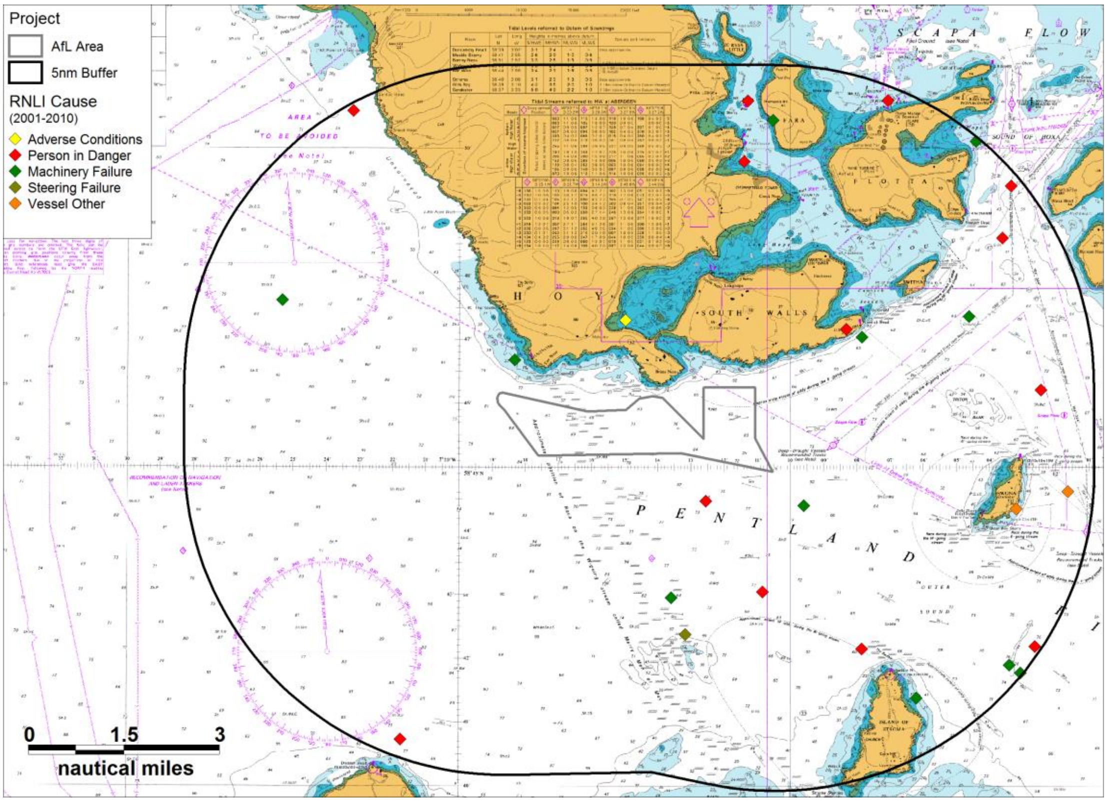


Figure 8.7 RNLI Incidents by Cause within 5nm of AfL Area

The reported causes are summarised in Figure 8.8.

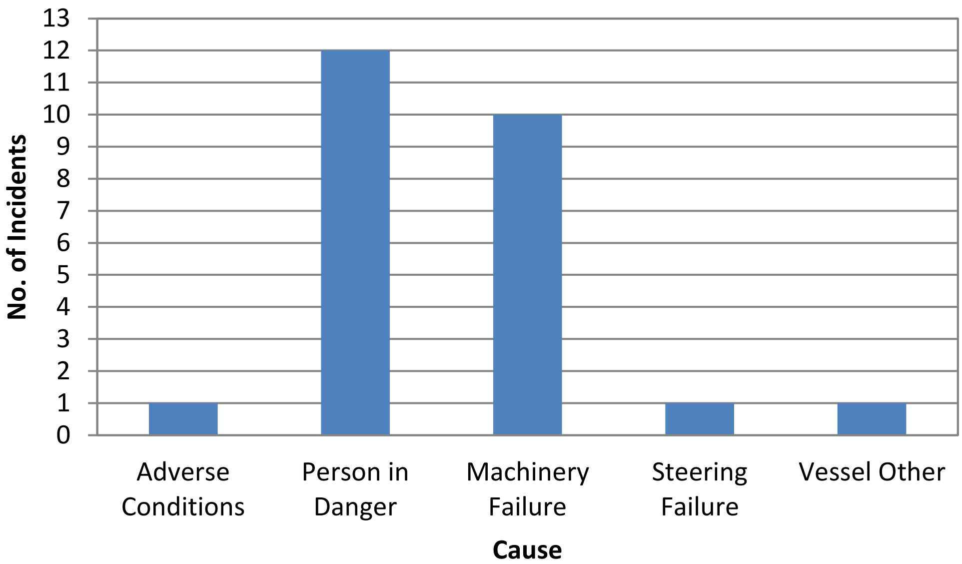


Figure 8.8 RNLI incidents by Cause within 5nm (2001-10)

The two main causes were person in danger (48%) and machinery failure (40%).

The annual rate of launches to incidents in the past ten years is summarised in Figure 8.9.

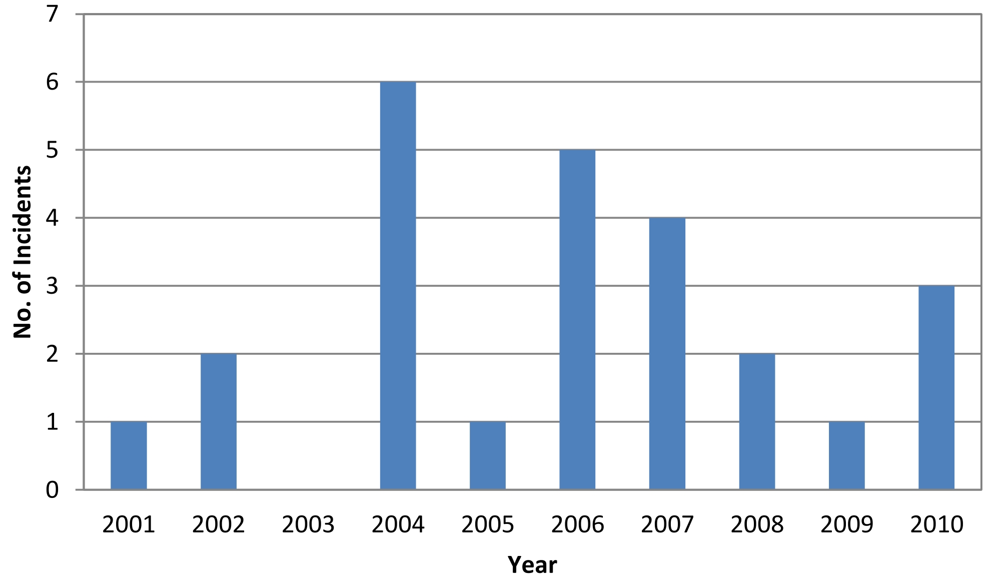


Figure 8.9 RNLI incidents by Year within 5nm (2001-10)

In terms of yearly variations, it can be seen that the number of launches to incidents fluctuated from none to six within the period analysed.

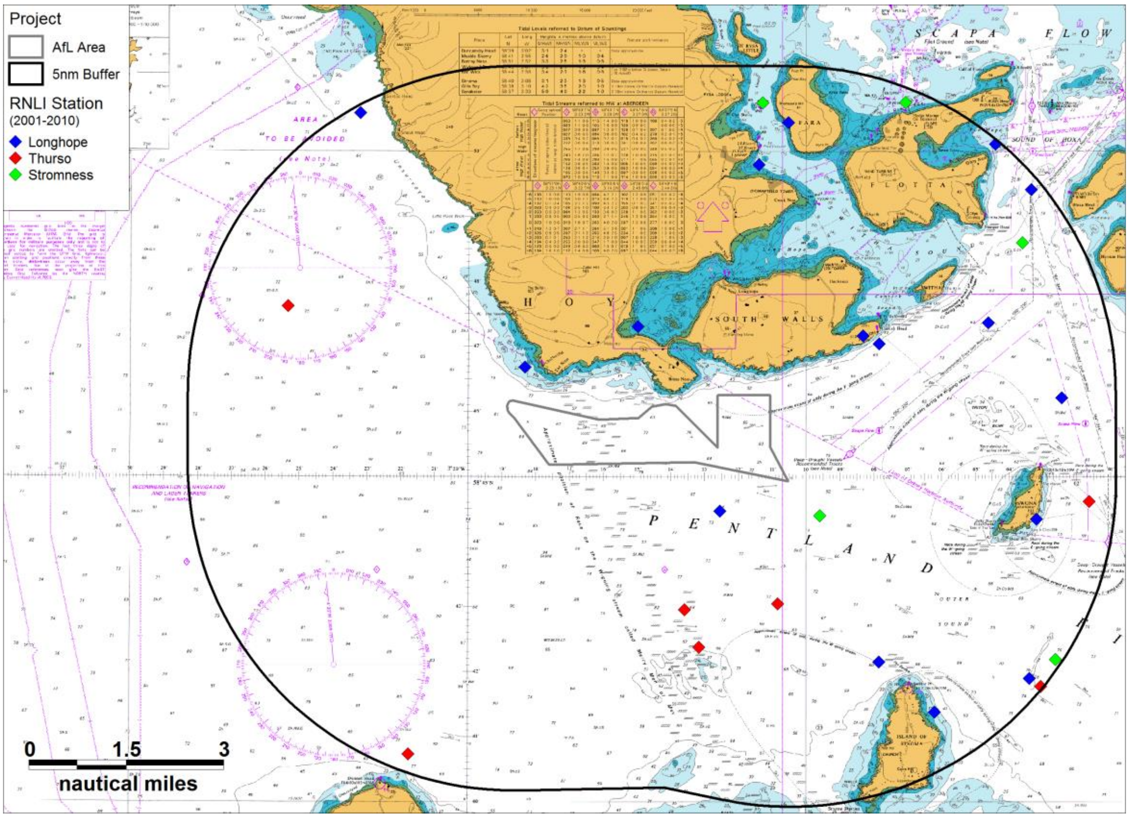


Figure 8.10 RNLI Incidents by Station within 5nm of AfL Area

Longhope station responded to the majority (59%) of the incidents in the 5nm buffer, Thurso responded to 24% and Stromness responded to 17% of incidents.

No incidents were recorded within the AfL area during the ten year period analysed. Three incidents occurred in close proximity to the AfL area and were examined in greater detail; one at 0.5nm north of the AfL area, one at 0.7nm south and one 0.7nm southeast. All other incidents were over 1nm from the AfL area. The incident to the north was the machinery failure on a potter on 9 July 2006, and can be cross-referenced by date and time as the same incident as that represented in the MAIB dataset. The incident to the south occurred on 11 November 2006, when Longhope ALB responded and gave assistance to an ill crewman onboard a large tanker. The incident to the southeast occurred on 16 March 2008, when Stromness ALB assisted a passenger vessel which had a machinery failure.

Further data have been received for a more recent period, 2011 to 2015 (19 May 2015). These data show an additional 13 launches to 12 unique incidents in this time period. Figure 8.11 presents the incident locations.

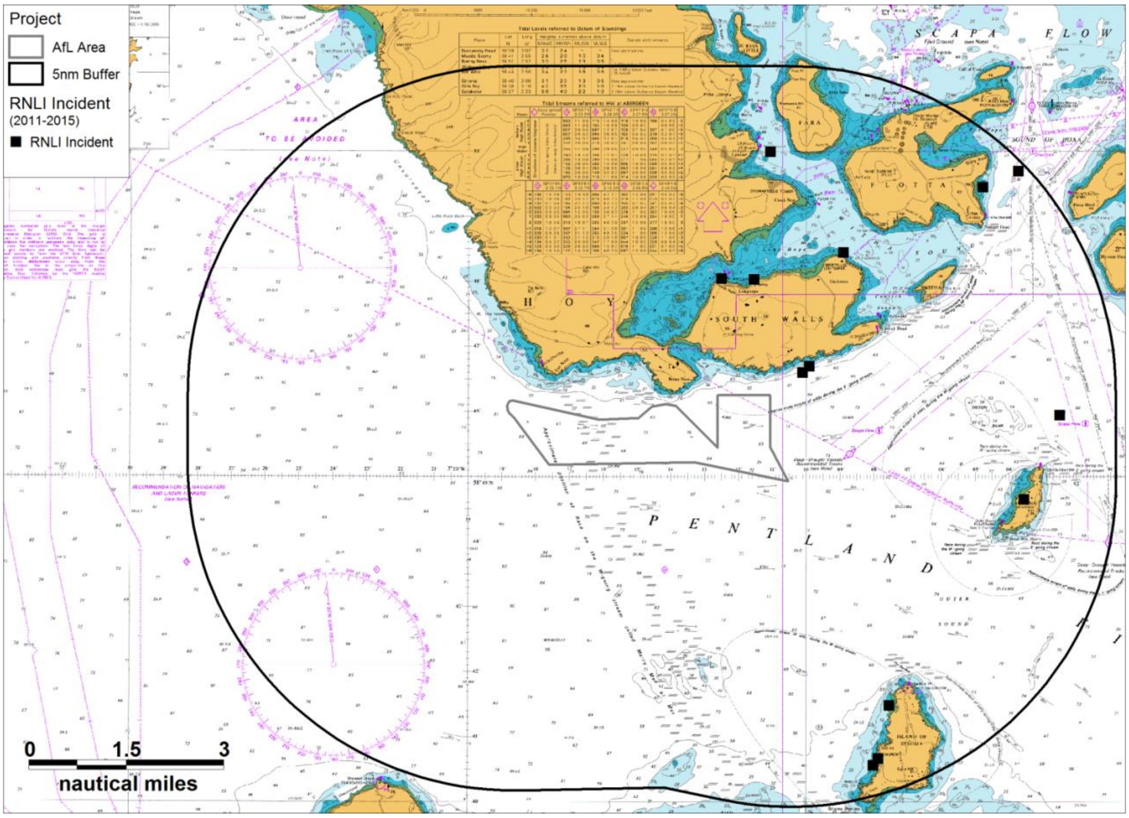


Figure 8.11 RNLI Incidents within 5nm of AfL Area

There were two incidents in the immediate vicinity of the AfL area, one 0.6nm northeast of the AfL area, and one 0.8nm northeast of the AfL area, both close to shore by Misbister Geo on South Walls. The incident 0.6nm northeast occurred on 5 January 2015, when Longhope RNLI responded to a commercial fishing vessel with machinery failure. The incident 0.8nm northeast occurred on 2 August 2013, when Kirkwall RNLI responded to a sailing yacht (equipped with engine) which was stranded / grounded.

8.4 Conclusion

Based on a review of the available incident data from MAIB and RNLI, the area in the vicinity of the proposed Brims Tidal Array has experienced a relatively low level of maritime incidents in recent years.

9. MARITIME TRAFFIC SURVEYS

9.1 Introduction

This section presents analysis of the maritime traffic data for the Brims Array within 5nm of the AfL area. The data has been collected using radar, AIS and visual observations from a site at Brims on Orkney, as presented in Figure 9.1. It covers 2 x 14 day periods, winter 2013 and summer 2014. Full details of both of these surveys have been presented as independent Maritime Traffic Survey reports for winter 2013 (Anatec, 2014a) and summer 2014 (Anatec, 2014b).

9.2 Vessel Type

9.2.1 Vessel Type within 5nm Buffer

Plots of the vessel tracks for the winter and summer fortnights, thematically mapped by vessel type, are presented in Figure 9.1 and Figure 9.2.

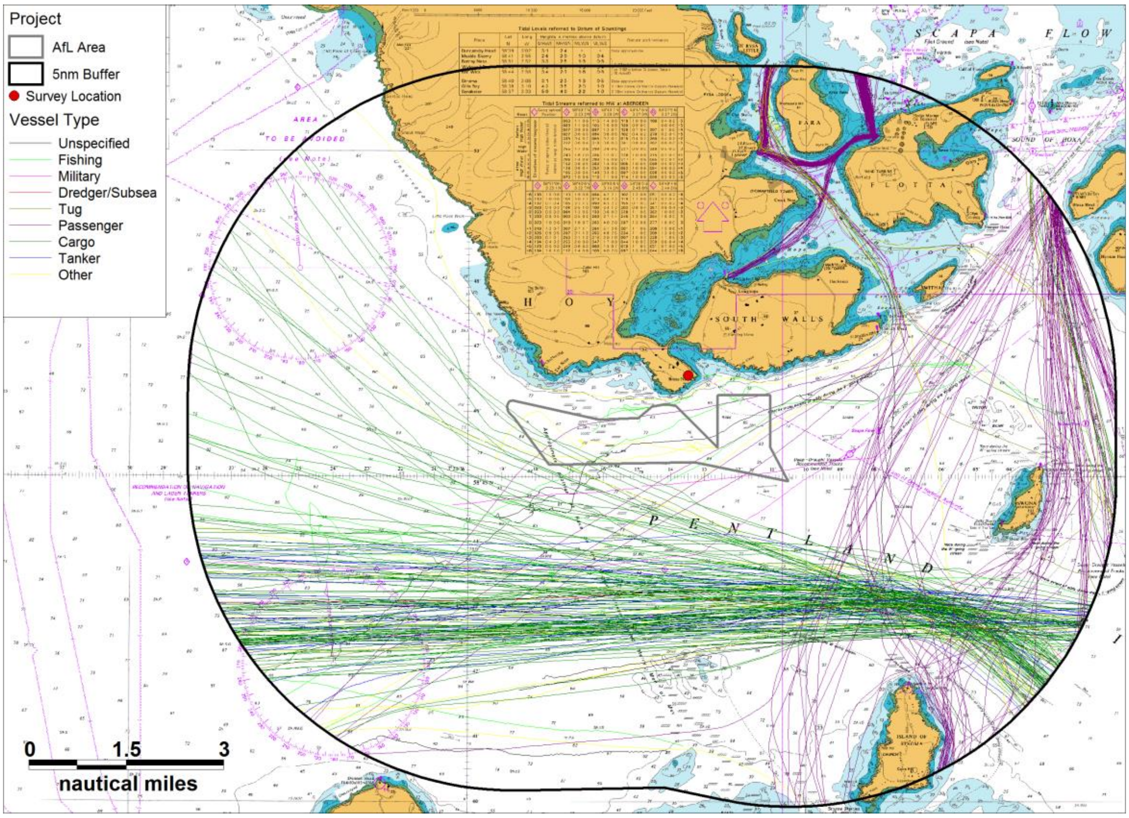


Figure 9.1 Winter 2013 AIS and Radar Data (14 Days) within 5nm Buffer

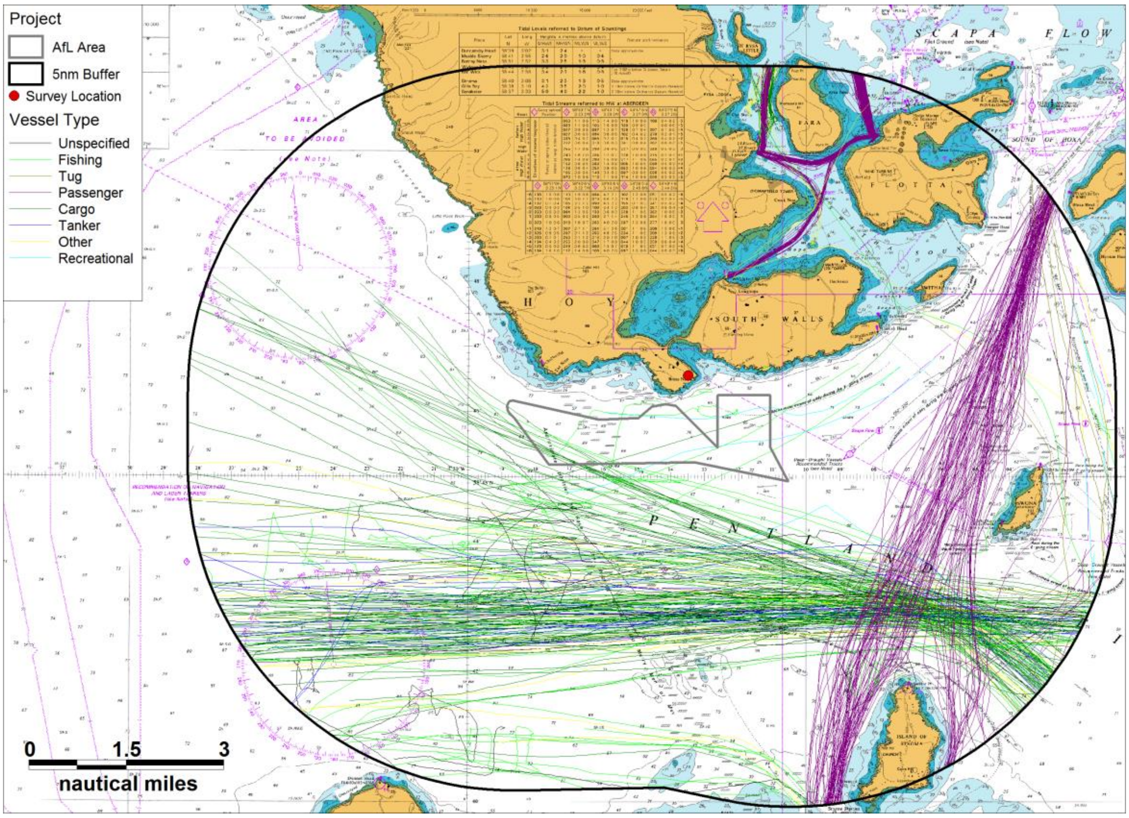


Figure 9.2 Summer 2014 AIS and Radar Data (14 Days) within 5nm Buffer

Within the 5nm buffer, there was an average of 25 unique vessels per day in winter 2013, and 21 per day in summer 2014. The largest proportion of these were cargo vessels and tankers using the Outer Sound of the Pentland Firth and passing south of the AfL area.

9.2.2 Vessel Type within AfL Area

Figure 9.3 and Figure 9.4 present detailed plots of vessel tracks in the vicinity of the Brims AfL area, thematically mapped by vessel type, in the winter 2013 and summer 2014 periods, respectively.

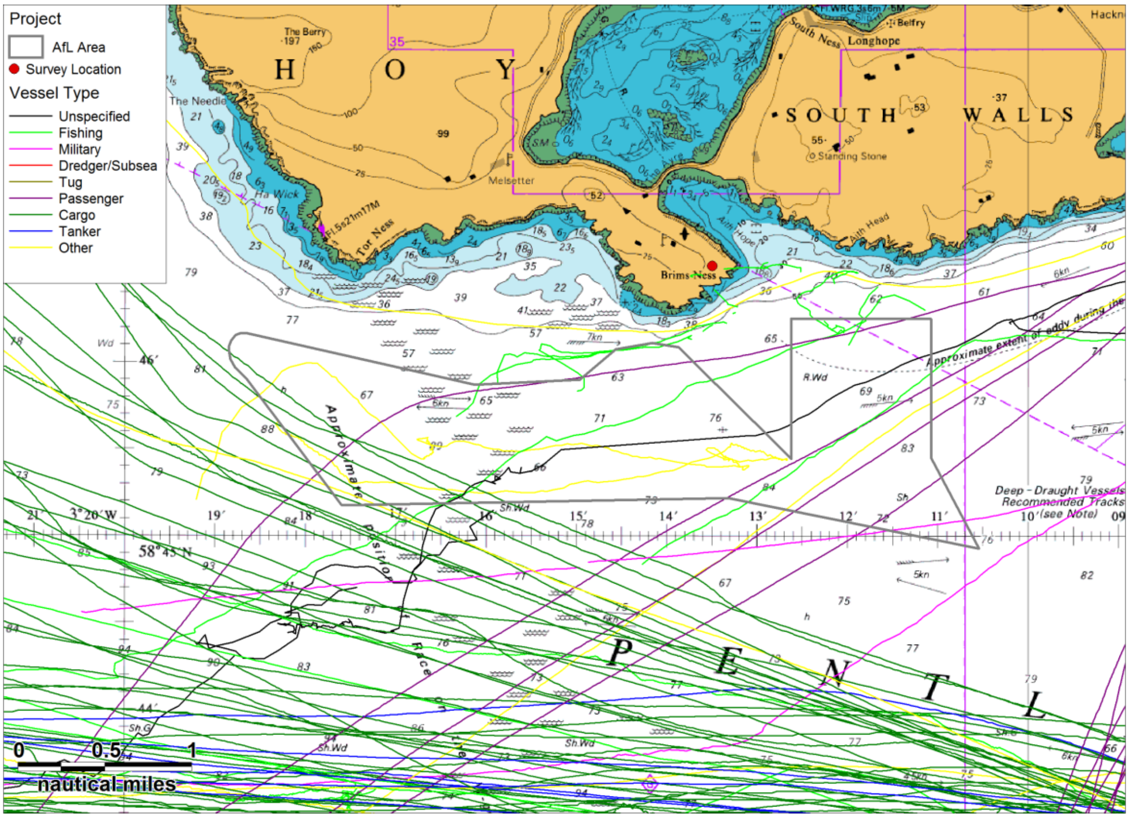


Figure 9.3 Winter 2013 AIS and Radar Data (14 Days) in proximity to AfL Area

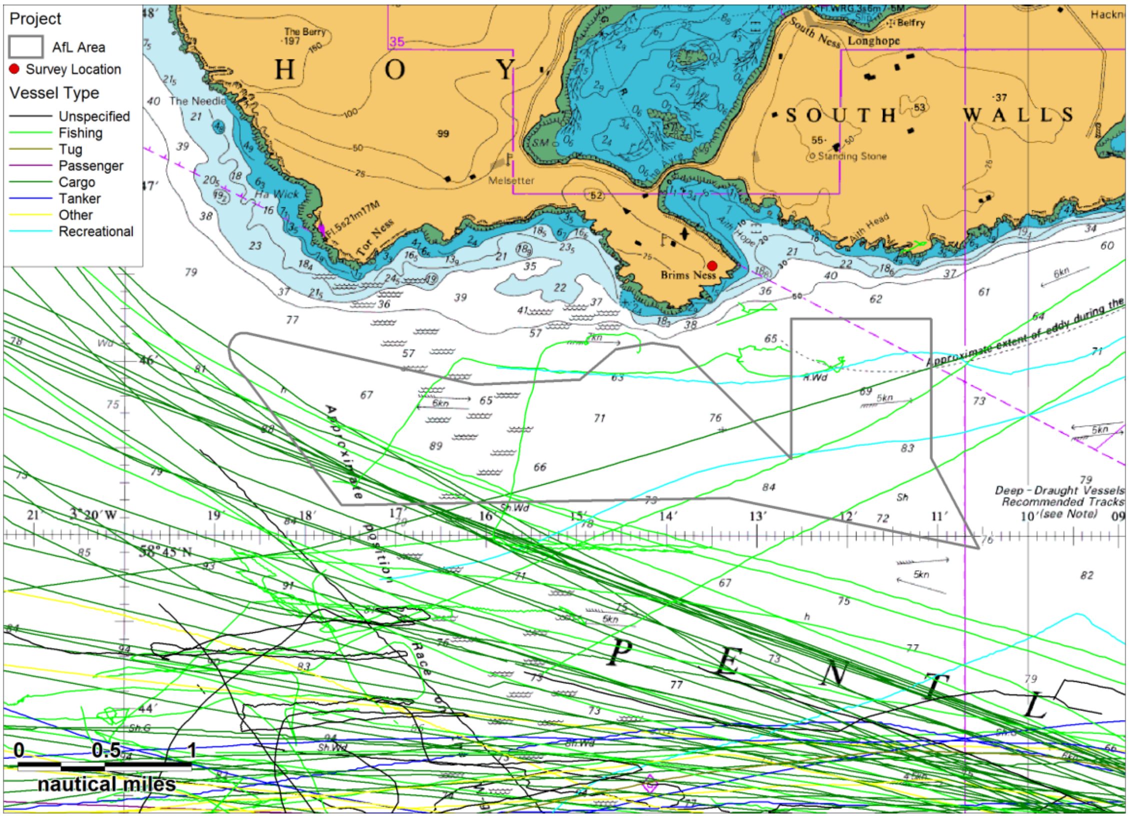


Figure 9.4 Summer 2014 AIS and Radar Data (14 Days) in proximity to AfL Area

The daily number of vessels recorded passing within the AfL area during the winter 2013 and summer 2014 survey periods, is presented in Figure 9.5.

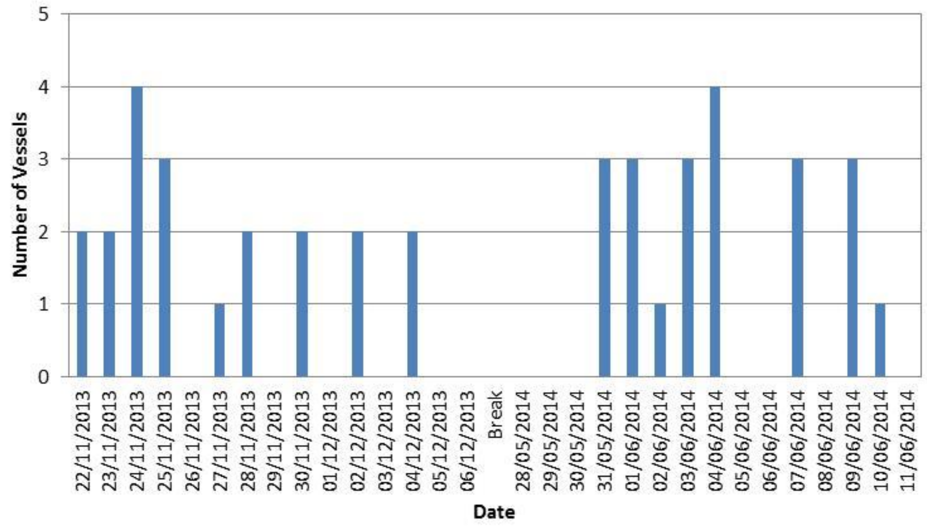


Figure 9.5 Unique Vessels per Day within AfL Area (Winter 2013 and Summer 2014)

The vessel type distribution within the AfL area during the two survey periods is presented in Figure 9.6.

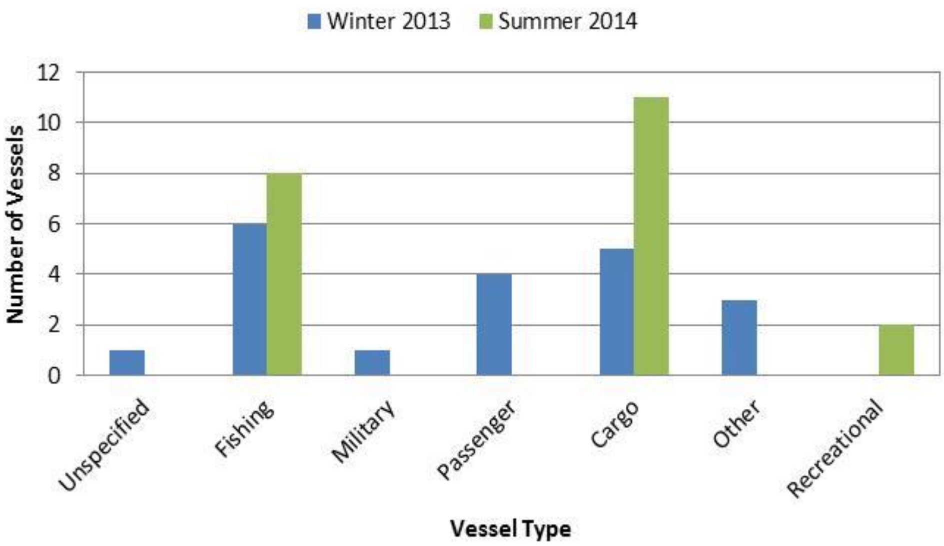


Figure 9.6 Vessel Type Distribution within AfL Area (Winter 2013 and Summer 2014)

During the winter 2013 survey, there were 20 vessels tracked intersecting the AfL area. The busiest day (24 November 2013) saw four vessels, and there were several days where no activity was recorded in the AfL area. Of the 20 vessels that passed through the AfL area, six were fishing vessels, five cargo vessels, four passenger vessels, one military, three classed as "other" and one unidentified.

In the summer 2014 survey, there were 21 vessels tracked through the AfL area over the 14 days. The busiest day (4 June 2014) had four vessels, whereas several days had no recorded activity within the AfL area. Of the 21 vessels, 11 were cargo ships, eight were fishing vessels and two were recreational vessels.

9.3 Vessel Length

9.3.1 Vessel Length within 5nm Buffer

Based on the information available from AIS and visual observation of the radar targets (where possible), the tracks thematically mapped by length are presented in Figure 9.7 and Figure 9.8.

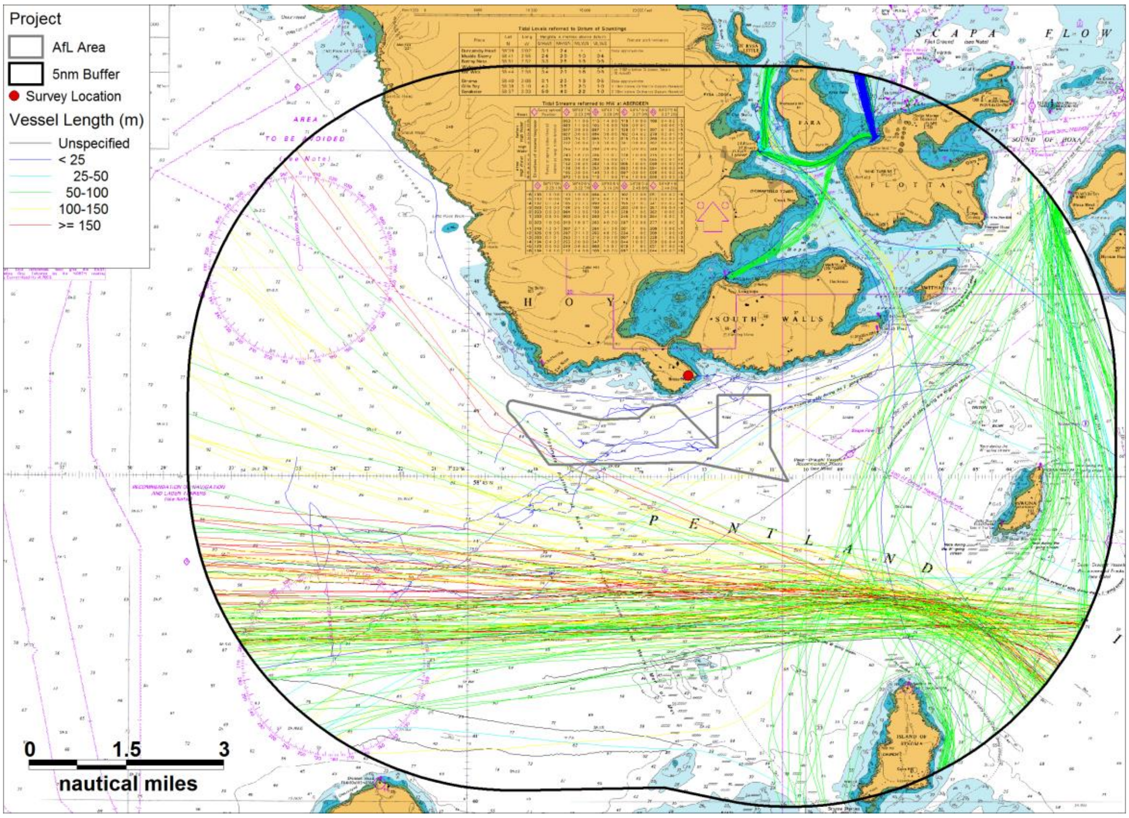


Figure 9.7 Winter 2013 AIS and Radar Data by Length (14 Days) within 5nm Buffer

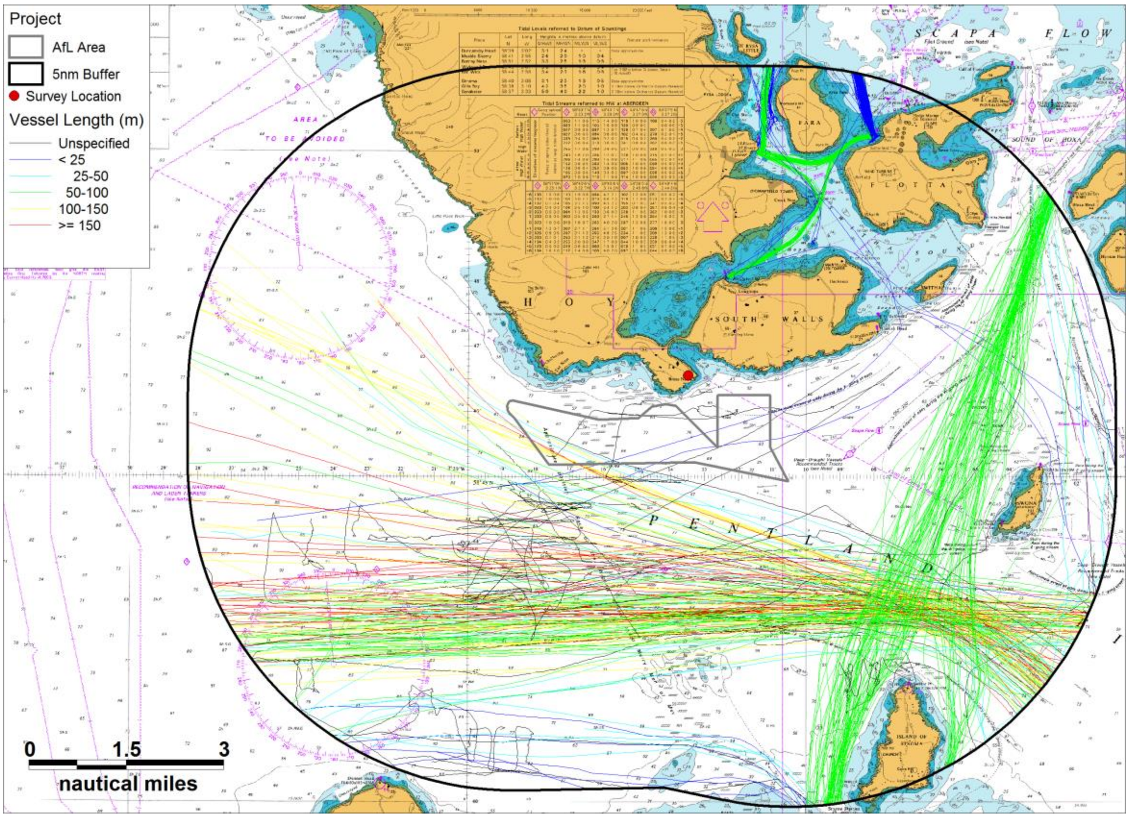


Figure 9.8 Summer 2014 AIS and Radar Data by Length (14 Days) within 5nm Buffer

The average vessel length in winter 2013 was 89m, and in the summer 2014 survey it was 86m. The longest vessel passing within the 5nm buffer, transiting eastbound through the Pentland Firth on 7 June 2014, was the cargo vessel *MSC Michaela* at 304m.

9.3.2 Vessel Length within AfL Area

Figure 9.9 and Figure 9.10 present detailed plots of vessel tracks in the vicinity of the Brims AfL area, thematically mapped by vessel length, in the winter 2013 and summer 2014 periods, respectively.

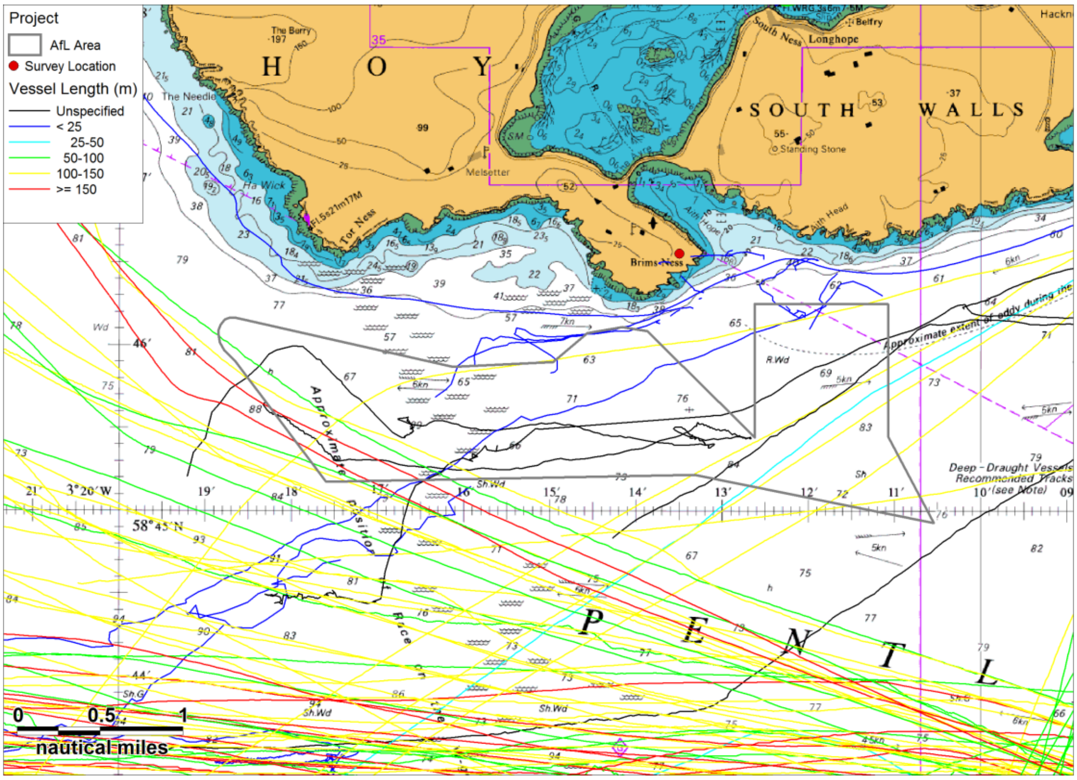


Figure 9.9 Winter 2013 AIS and Radar Data by Length (14 Days) in proximity to AfL Area

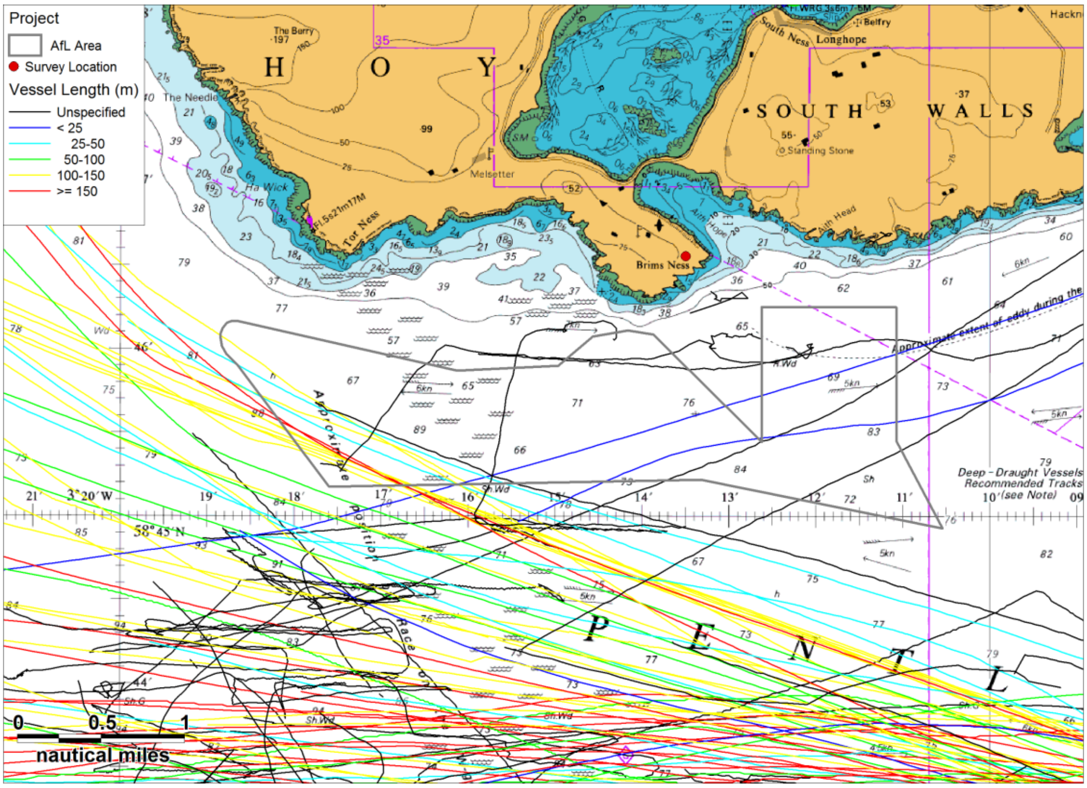


Figure 9.10 Summer 2014 AIS and Radar Data by Length (14 Days) in proximity to AfL Area

Figure 9.11 presents the vessel length distribution within the AfL area.

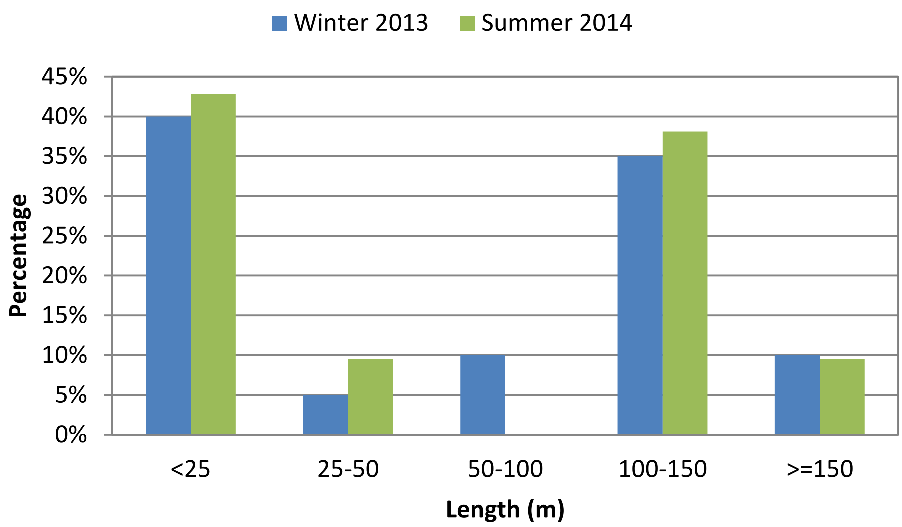


Figure 9.11 Vessel Length Distribution within AfL Area (Winter 2013 and Summer 2014)

In the winter 2013 survey, eight of the vessels that passed through the AfL area were <25m, one was between 25m and 50m, two were between 50m and 100m, seven were between 100m and 150m, and 2 were > 150m.

In summer 2014, nine of the vessels that passed through the AfL area were <25m, two were between 25m and 50m, eight were between 100m and 150m long, and two were over 150m long.

In both periods, the longest vessel tracked was the 165m cargo vessel *Godafoss*. This vessel passed through the AfL area on 12 December 2013 and 7 June 2014, travelling to Rotterdam on both occasions.

9.4 Vessel Draught

9.4.1 Vessel Draught within 5nm Buffer

Based on the information available from AIS, the tracks thematically mapped by draught within the 5nm buffer are presented in Figure 9.12 and Figure 9.13.

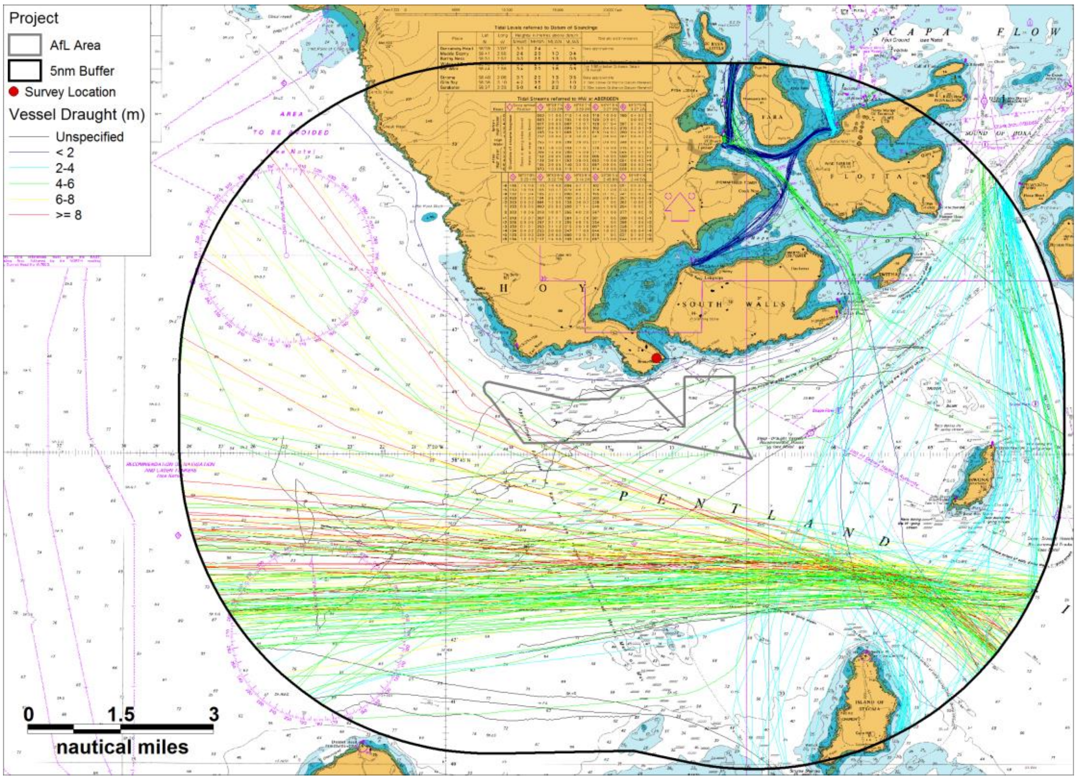


Figure 9.12 Winter 2013 AIS and Radar Data by Draught (14 Days) within 5nm Buffer

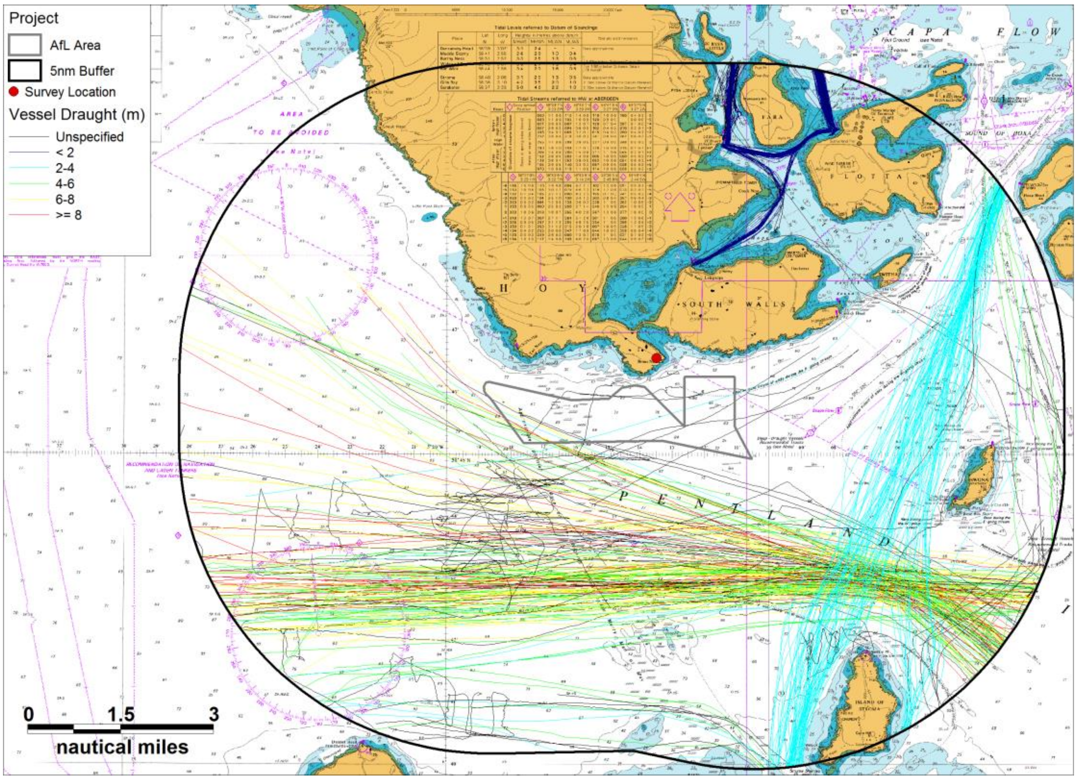


Figure 9.13 Summer 2014 AIS and Radar Data by Draught (14 Days) within 5nm Buffer

In winter 2013, 13 vessels with a draught of 10m or greater were recorded within the 5nm buffer, but these did not enter the AfL area. In summer 2014, 11 unique vessels with a draught of 10m or greater were tracked, but did not intersect the AfL area. These deeper draught vessels were mainly transiting the Outer Sound of the Pentland Firth.

9.4.2 Vessel Draught within AfL Area

Figure 9.14 and Figure 9.15 present detailed plots of vessel tracks in the vicinity of the AfL area, thematically mapped by vessel draught, in the winter 2013 and summer 2014 periods, respectively.

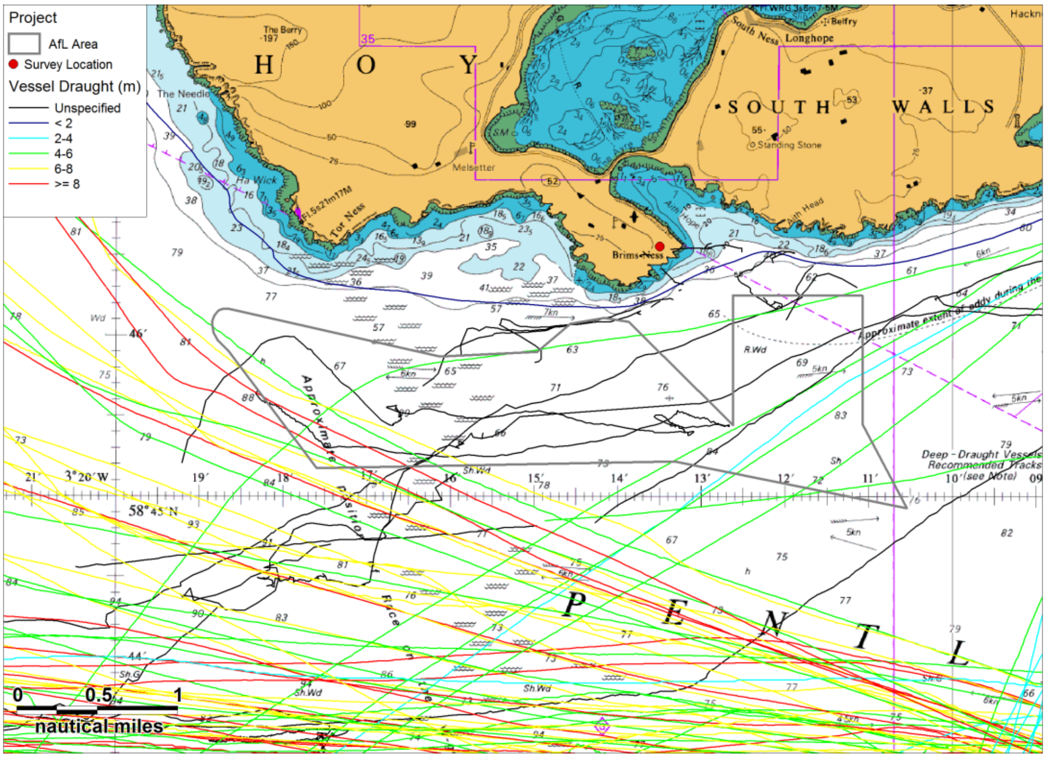


Figure 9.14 Winter 2013 AIS and Radar Data by Draught (14 Days) in proximity to AfL Area

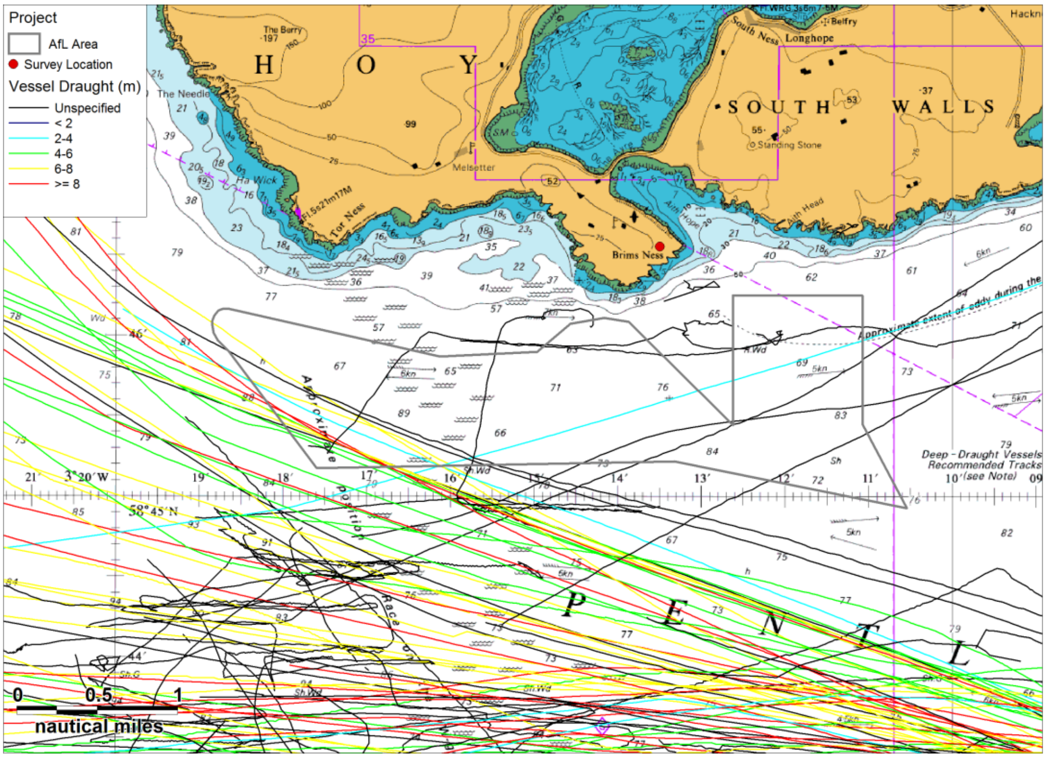


Figure 9.15 **Summer 2014 AIS and Radar Data by Draught (14 Days) in proximity to AfL Area**

Figure 9.16 presents the vessel draught distribution within the AfL area during the two survey periods.

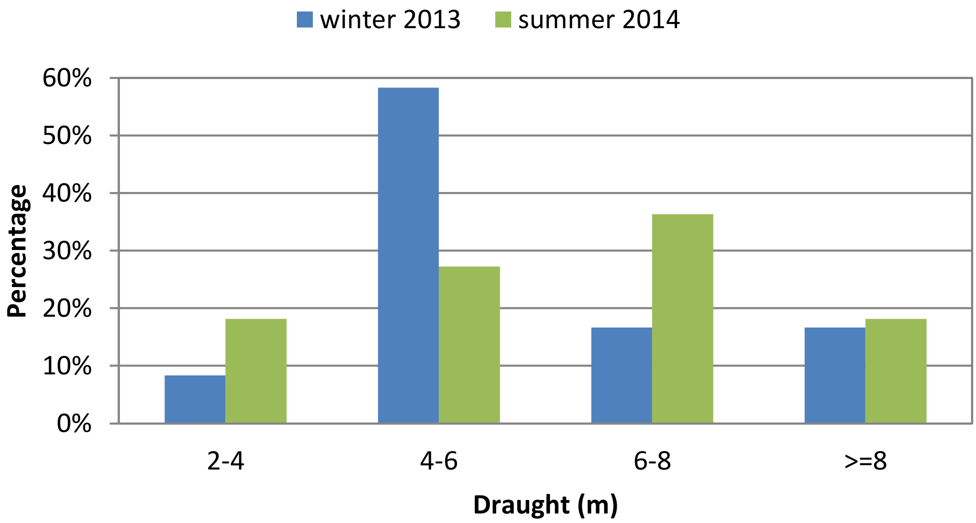


Figure 9.16 **Vessel Draught Distribution within AfL Area (Winter 2013 and Summer 2014)**

Passing through the AfL area in the winter 2013 period, one vessel had a draught of less than 4m, seven vessels had a draught of 4-6m, two vessels had a draught of 6-8m and two vessels had a draught of ≥8m.

In the summer 2014 period, within the AfL area, two vessels had a draught of less than 4m, three vessels had a draught of 4-6m, four vessels had a draught of 6-8m and two vessels had a draught of ≥8m. The AIS vessels *Ruby* and *Kristrun II RE 477* did not broadcast their actual draught but the design draught of the vessels is 6.65m and 3.4m respectively. No information was available for the sailing vessel *Coast Inn* which was recorded on AIS, however as it is only 6m long the draught is expected to be well below 4m.

In both periods, the deepest draught vessel was cargo vessel *Godafoss* (9.1m in winter 2013 and 8.9m in summer 2014), en route to Rotterdam on both occasions. The draught of the non-AIS vessel tracks were unspecified, however, these were visually identified as small vessels of less than 5m draught.

9.5 Vessel Course

Vessel tracks, thematically mapped by average course within 5nm, are presented in Figure 9.17 and Figure 9.18 for the winter and summer periods respectively. There are no Traffic Separation Schemes in the area so the courses are fairly evenly divided in each direction.

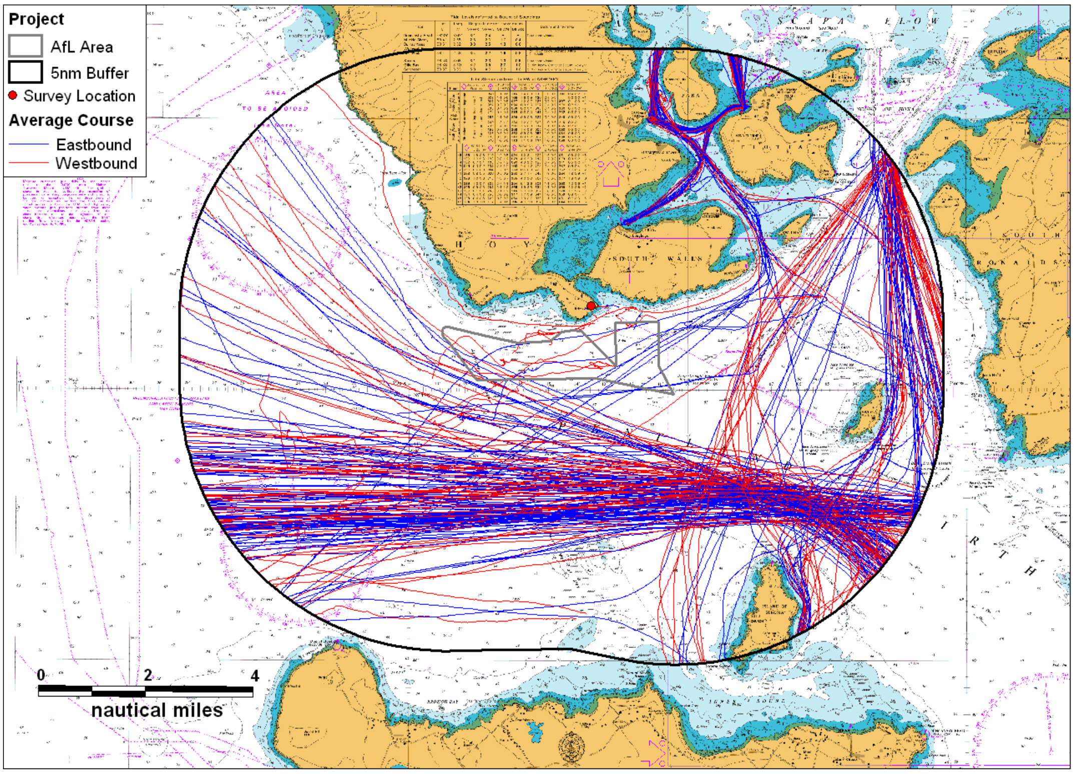


Figure 9.17 Winter 2013 AIS and Radar Data by Average Course (14 Days) within 5nm Buffer

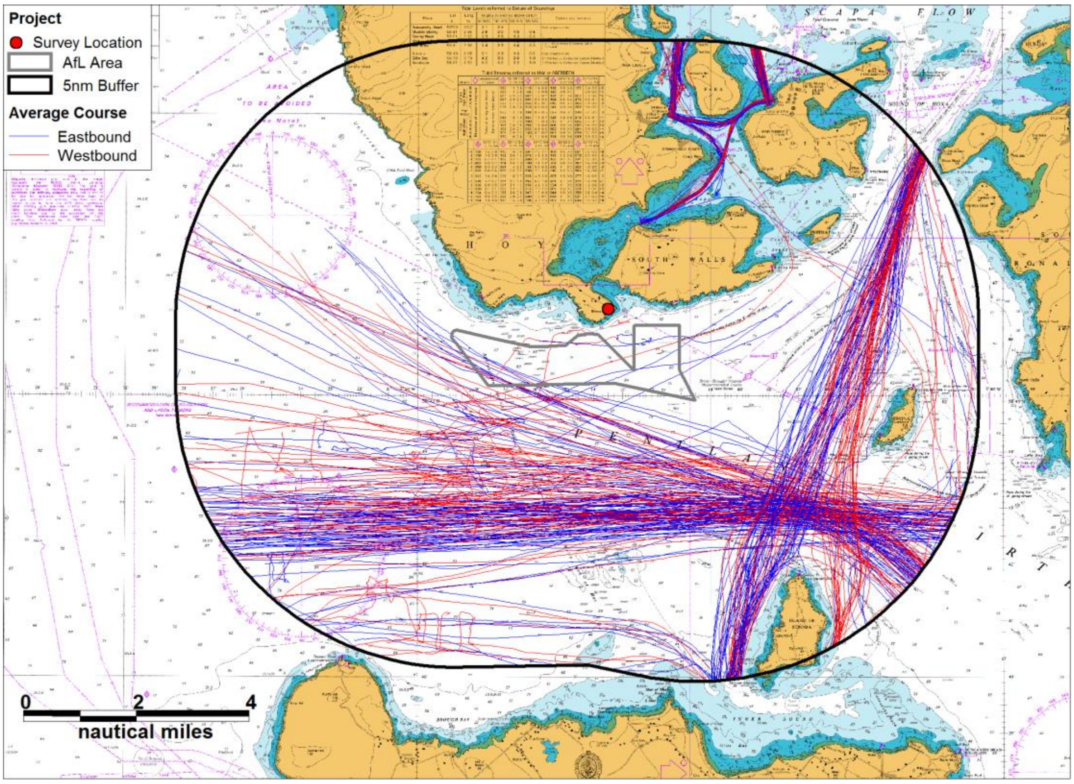


Figure 9.18 Summer 2014 AIS and Radar Data by Average Course (14 Days) within 5nm Buffer

9.6 Vessel Speed

Vessel tracks, thematically mapped by average speed within 5nm, are presented in Figure 9.19 and Figure 9.20.

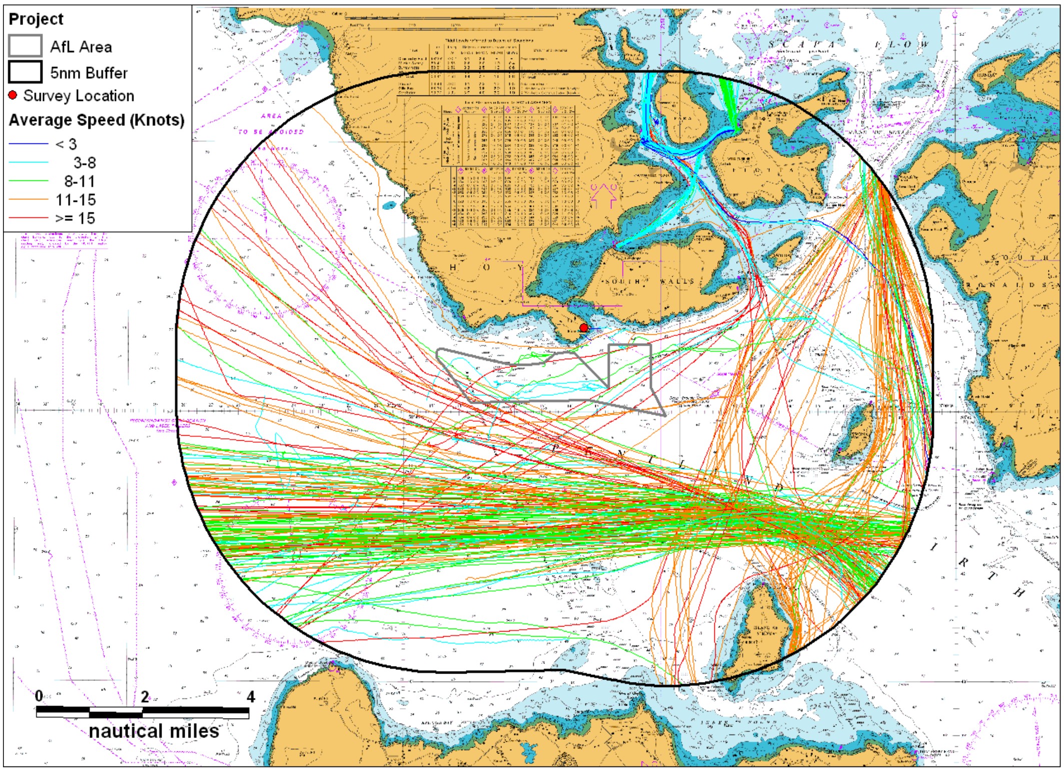


Figure 9.19 Winter 2013 AIS and Radar Data by Average Speed (14 Days) within 5nm Buffer

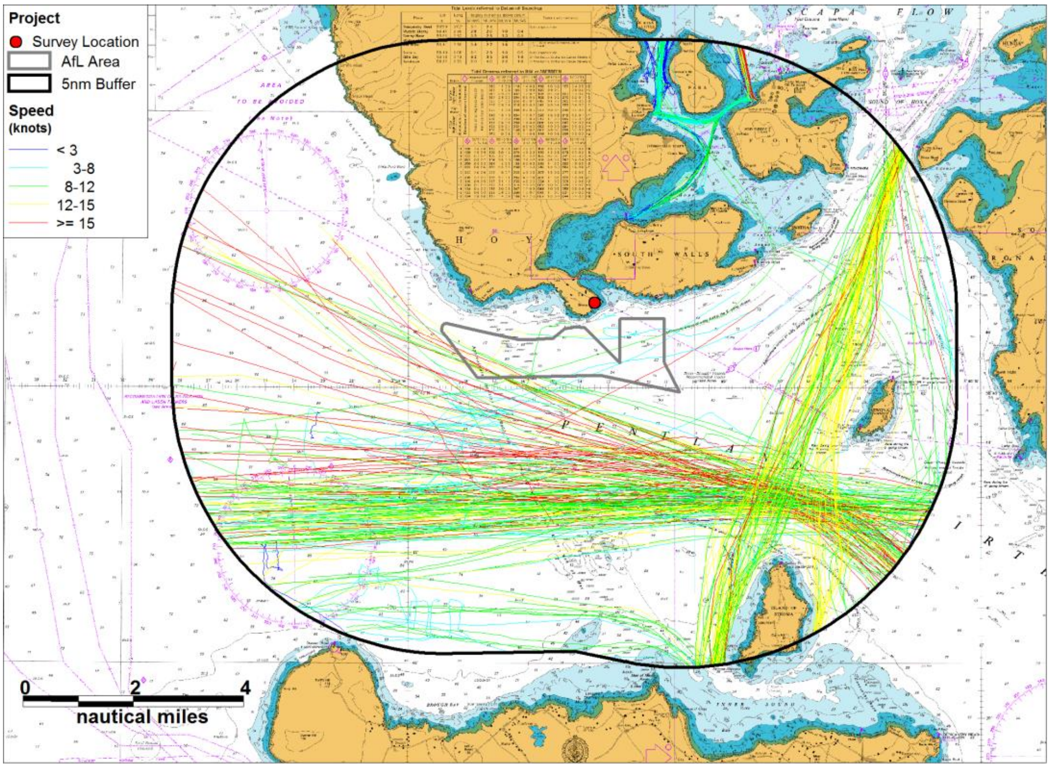


Figure 9.20 Summer 2014 AIS and Radar Data by Average Speed (14 Days) within 5nm Buffer

The average speed of vessels within 5nm in both winter and summer was 9-10 knots. The fastest vessel was the *RNLI Lifeboat 17-46* travelling at 27.3 knots.

The average speed of tracks crossing the AfL area was slightly higher at 11-12 knots. The fastest vessel was the container ship *Dettifoss* at 21.1 knots.

9.7 Destination

9.7.1 Destination within 5nm Buffer

In the winter 2013 survey within the 5nm buffer, the most common destination was Flotta, which was the stated destination for 17 vessels. Other common destinations were Gills Bay (12) and St Margarets Hope (12) used by the *Pentalina* ferry, Aberdeen (8), and Immingham (8).

Within the summer 2014 survey in the 5nm buffer, the most common destination was Scapa Flow, which was the stated destination for 16 vessels. Other common destinations were St Margaret's Hope (15) and Gills Bay (14) used by the *Pentalina* ferry, Lyness (9) and Immingham (7).

9.7.2 Destination within AfL Area

In winter 2013, destinations were broadcast by all 12 AIS targets passing within the AfL area. The passenger vessel *Hamnavoe* made regular journeys between Stromness and Scrabster. Reykjavik was the destination of cargo vessels *Selfoss* and *Laxfoss* and Rotterdam was the destination of cargo vessels *Godafoss* and *Dettifoss*.

During the summer 2014 survey, destinations were broadcast by 12 of the 14 AIS targets passing within the AfL area. The cargo vessel *Ruby* was recorded in the AfL area heading to Torshaven, the Faroe Islands on three occasions, and Aberdeen on one occasion. Rotterdam was the recorded destination for the cargo vessels *Godafoss* and *Dettifoss.* The cargo vessel *Selfoss* and the fishing vessel *Kristrun II RE 477* were destined for Reykjavik. Immingham on Humberside was the recorded destination of the cargo vessels *Selfoss and Bruarfoss*.

9.8 Vessels Intersecting AfL Area

Table 9.1 and Table 9.2 present details of the vessels tracked intersecting the AfL area in the winter 2013 and summer 2014 periods, respectively.

Table 9.1 Vessels Passing within AfL Area (Winter 2013)

Name (or Description)	Type	Number of Transits	Length (m)	Draught (m)	AIS
Hamnavoe	Ferry	4	112	4.4	Yes
Caspian	Fishing	2	8	N/A	No
Selfoss	Cargo	2	127	7.3	Yes
Guiding Light	Fishing	2	12.9	N/A	No
Blue Hulled Potter	Fishing	1	<25	N/A	No
Dettifoss	Cargo	1	164	8.6	Yes

Name (or Description)	Type	Number of Transits	Length (m)	Draught (m)	AIS
Godafoss	Cargo	1	165	9.1	Yes
Helen Burnie	Multi-purpose Support Vessel	1	25	2.5	Yes
Hirta	Fisheries Patrol	1	84	5.4	Yes
HMS Northumberland	Military	1	133	4.9	Yes
Laxfoss	Cargo	1	80	5	Yes
Samantha Jane	Fishing	1	12.6	N/A	No
Welcome Home	Sea angling charter	1	<25	N/A	No
Unidentified Vessel	Unspecified	1	<25	N/A	No

Table 9.2 Vessels Passing within AfL Area (Summer 2014)

Name (or Description)	Type	Number of Transits	Length (m)	Draught (m)	AIS
Ruby	Cargo	5	101	6	Yes
Samantha Jane	Fishing	3	12.6	N/A	No
Selfoss	Cargo	2	127	7.2	Yes
Fame	Cargo	1	15	3.9	Yes
Godafoss	Cargo	1	165	8.9	Yes
Dettifoss	Cargo	1	164	8.9	Yes
Bruarfoss	Cargo	1	126	7.1	Yes
Kristrun II RE 477	Fishing	1	36	N/A	Yes
Coast Inn	Sailing	1	6	N/A	Yes
Caspian	Fishing	1	8	N/A	No
Guiding Light	Fishing	1	12.9	N/A	No
‘RV87’ Trawler	Fishing	1	N/A	N/A	No
Endurance FR111	Fishing	1	25	N/A	Yes
Zuza	Sailing	1	N/A	N/A	No

9.9 Visual Observations

In addition to the recorded AIS and radar data, visual recordings were made of a small number of vessel positions that on occasion were not continuously tracked by the radar, for example, due to clutter and the small size of the target, making them difficult to acquire.

These positions were, in most cases, taken from the radar (range and bearing) as returns were visible on the screen even when the radar could not continuously track the targets.

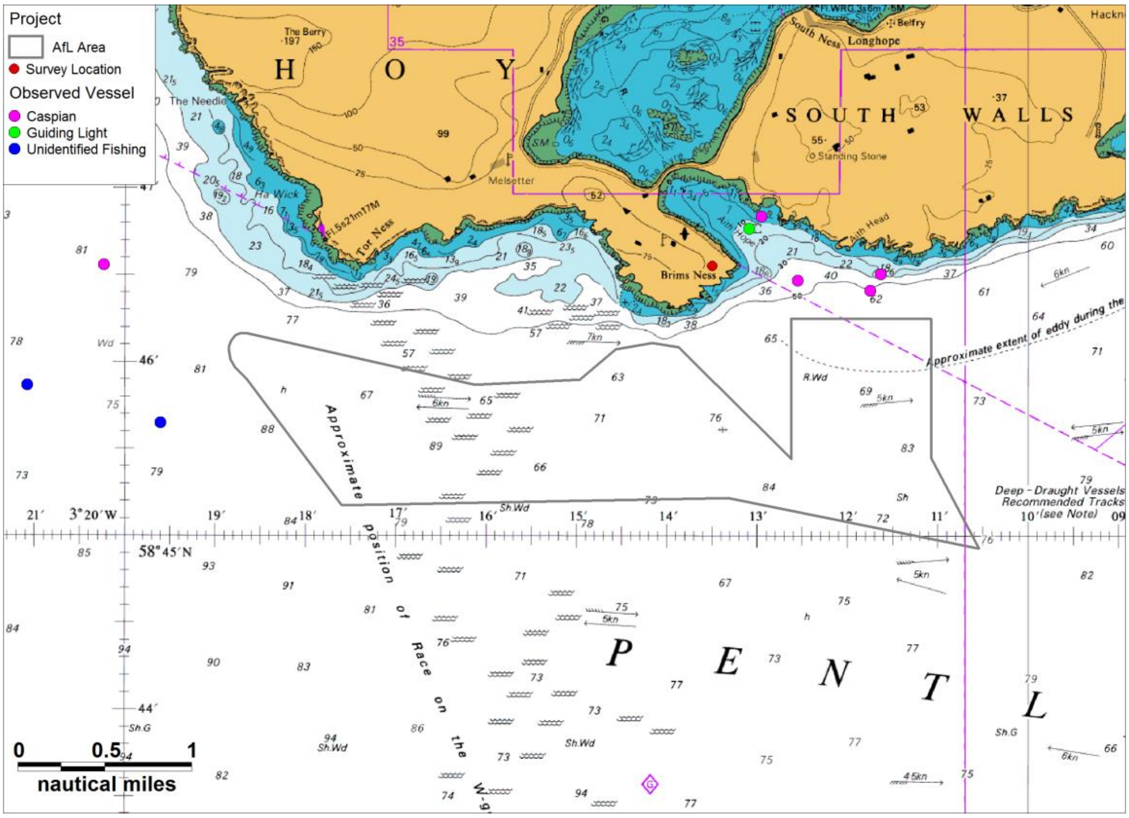


Figure 9.21 Winter 2013 Visually Logged Vessels

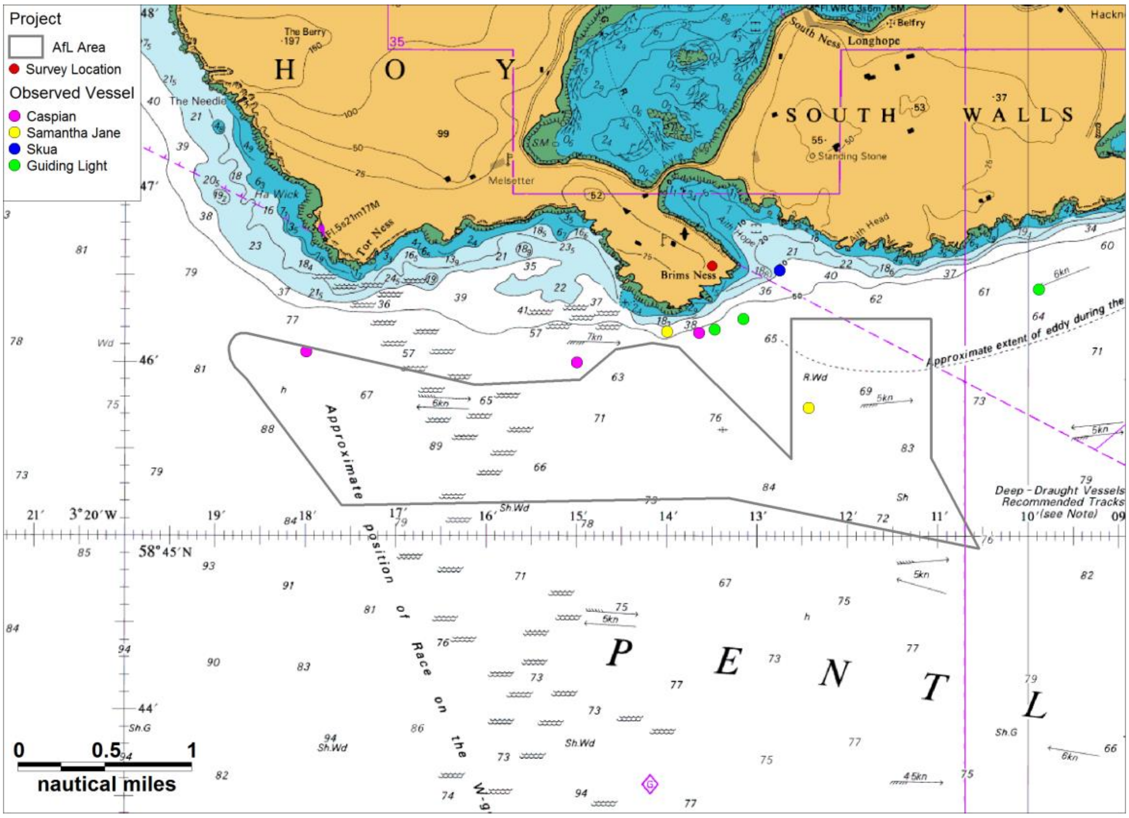


Figure 9.22 Summer 2014 Visually Logged Vessels

During the winter 2013 survey, there was a total of twenty manual observations, 16 of which were the fishing vessel *Caspian*. This vessel moored in Aith Hope at night and usually went to Aith Head for fishing operations during the day (a cluster of the points in Aith Head overlap). On two occasions it was seen travelling towards Tor Ness. The *Guiding Light* was observed twice, mooring in Aith Hope on the 23 November and leaving its mooring in Aith Hope on 25 November. Two of the visual observations were of an unidentified fishing vessel to the west of the AfL area.

In summer 2014, there was a total of nine visual observations over the course of the survey. Three of these were the *Caspian*, seen hauling creels. The *Guiding Light* was recorded three times visually and *Samantha Jane* twice. *Samantha Jane* was observed to be engaging in fishing on one of these occasions and steaming on the other. The *Guiding Light* engages in fishing west of Hoy and so was only seen steaming through the AfL area. *Skua* is a small angling vessel and was seen engaging in fishing.

10. REVIEW OF SHIPPING ACTIVITY

10.1 Introduction

This section reviews the activity and potential effects of the site on the following vessel types based on the survey data, as analysed in Section 9:

- Cargo Vessels
- Tankers
- Passenger Vessels
- Military Vessels
- Other vessels

Fishing and recreational vessel activity are covered separately in Sections 11 and 12, which draw upon other, longer-term data specific to each type.

10.2 Cargo Vessels

Figure 10.1 presents the cargo vessels recorded within the 5nm buffer during the 28 days.

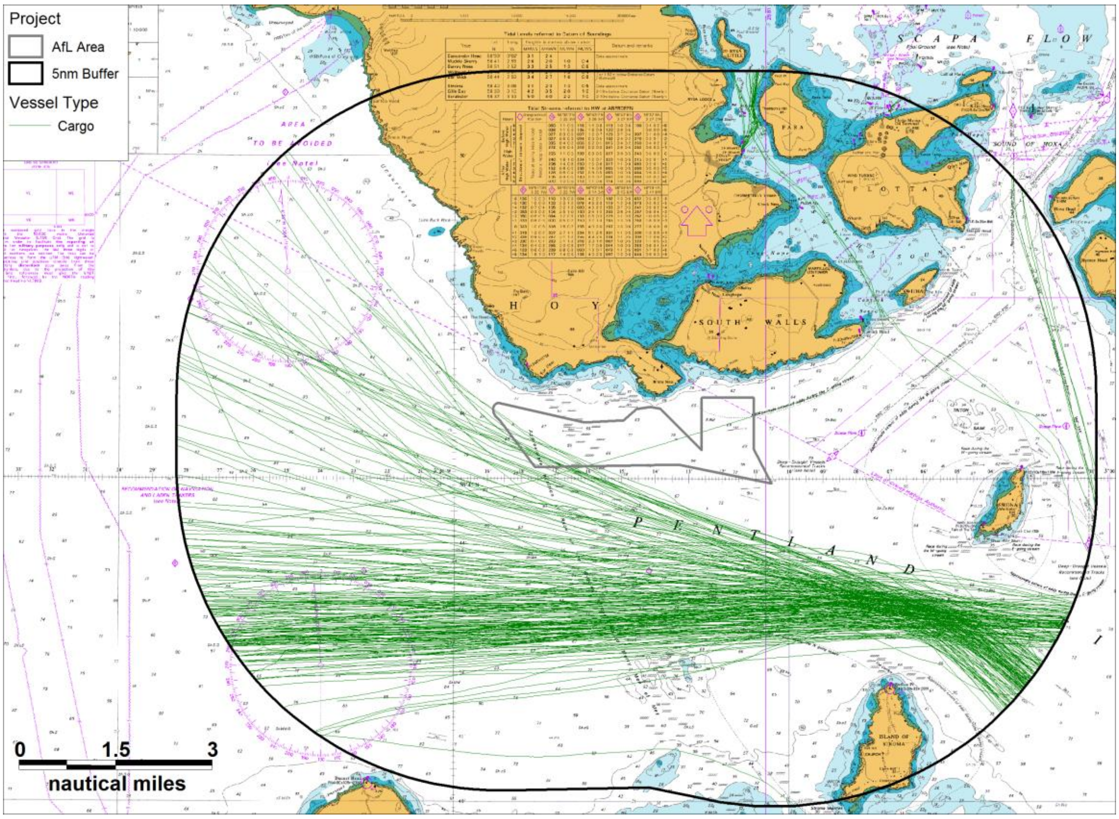


Figure 10.1 Cargo Vessel AIS and Radar Data (28 Days) within 5nm Buffer

The majority of cargo vessels within the 5nm buffer were transiting the Outer Sound of the Pentland Firth, with some vessels also passing west of Hoy.

A total of 16 cargo vessel tracks made by seven different vessels were recorded passing through the AfL area. All cargo vessels recorded in the AfL area travelled through the southwest corner and passed west of Hoy with the exception of *Fame* which transited through the eastern boundary on 4 June 2014.

The most frequently recorded cargo vessel in the winter 2013 survey was *Selfoss*, which transited the AfL area twice, the first time travelling northwest to Reykjavik and the second time southeast to Immingham. Other cargo vessels which passed through the AfL area were *Dettifoss* and *Godafoss*, both travelling eastbound to Rotterdam, and *Laxfoss* transiting westbound to Rotterdam.

During the summer 2014 survey the most frequently recorded cargo vessel was the *Ruby*, which transited the site five times, travelling west to Torshavn. Other cargo vessels travelling through the AfL area were *Selfoss* and *Godafoss* which were travelling to Reykjavik and Rotterdam respectively. Cargo vessels passing through the AfL area ranged in length from 15m to 165m and 3.9m to 9.1m draught.

10.3 Tankers

Figure 10.2 presents a chart overview of all tankers recorded during the 28 days of surveying.

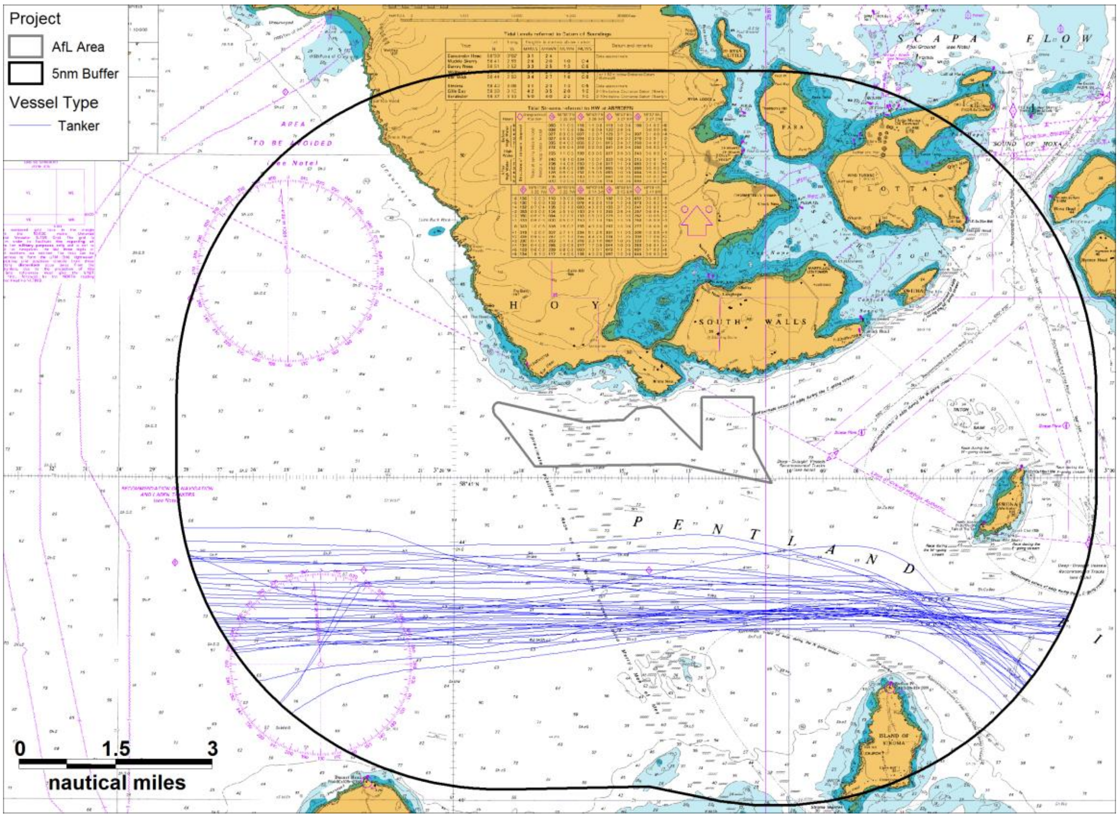


Figure 10.2 Tanker Vessel AIS and Radar Data (28 Days) within 5nm Buffer

All tankers were tracked using the Outer Sound of the Pentland Firth. None were recorded within the AfL area, with the closest passing 1nm south. However, it is known that ship-to-ship transfers in Scapa Flow were suspended at that time, and that tankers routinely visit the Flotta Marine Oil Terminal.

Figure 10.3 presents additional analysis of tanker AIS data, recorded during two 28 day periods in summer and winter 2010, which was used in the Preliminary Hazard Analysis (See Appendix B for more details).

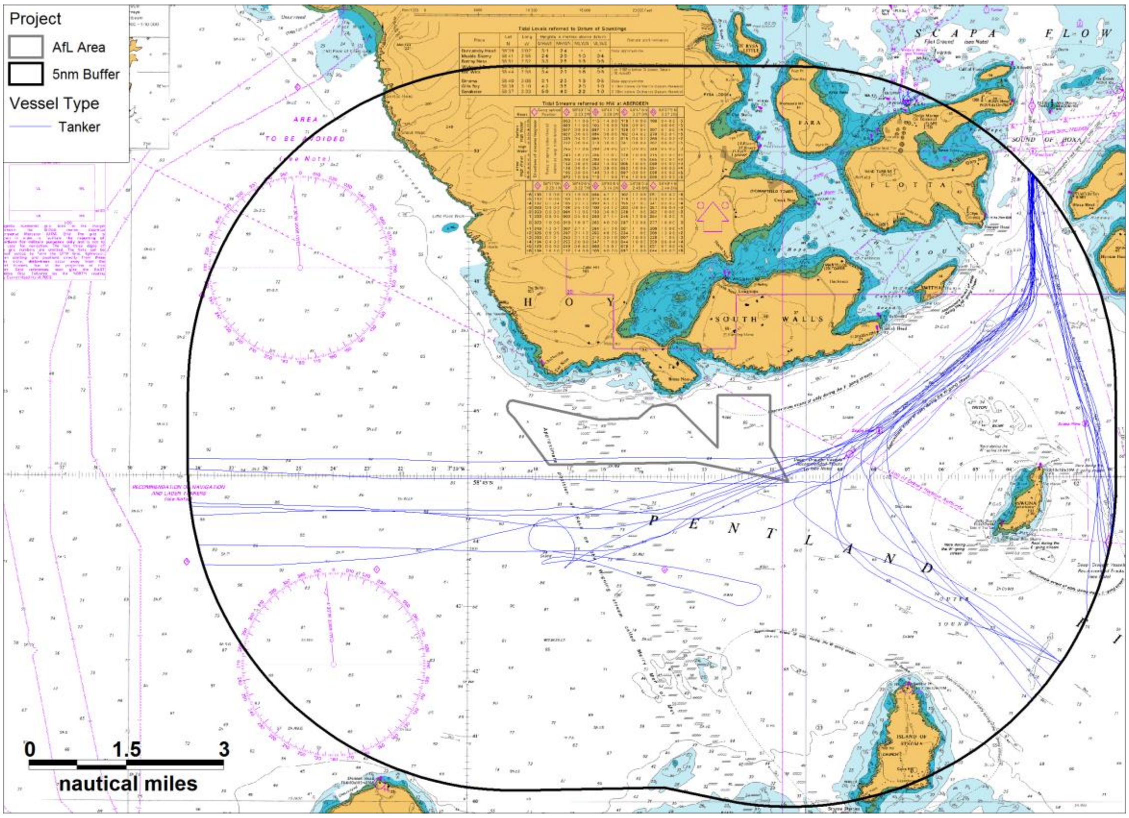


Figure 10.3 Tanker Vessel AIS Data (56 Days Summer and Winter 2010) within 5nm Study Area

These data show tankers entering and leaving Scapa Flow, via the recommended tracks for deep draught vessels. Nine vessels were recorded entering or leaving via the SW passage, west of Swona, some of which clipped the SE corner of the Brims AfL area. Four tankers were observed using the SE track, east of Swona. The deepest draught tanker recorded using the recommended tracks during the 56 day period was the *Navion Europa*, exiting Scapa Flow using the western recommended track, with a draught of 15.8m en route between Flotta Terminal and Rotterdam.

At the Hazard Review Workshop, the Deputy Orkney Harbour Masters noted that VLCCS had been calling since March 2015 when ship-to-ship transfers restarted. From review of a four month period from late-March to late-July 2015 of deep draught (greater than or equal to 12m) tanker movements, eight tanker tracks were recorded entering / exiting Scapa Flow from a direction west of the AfL area. The deepest draught tanker on this route was *Alsace*, with a draught of 20.8m, bound for Scapa Flow on 8 April 2015. A further eight tracks approached from the east and stayed to the east of the AfL area when navigating to/from Scapa Flow. The deepest draught tanker tracked on this route was *Sifa*, with a draught of 21.5m, en route to China on 18 April 2015. Figure 10.4 summarises the draught distribution of all the large tankers using the recommended deep draught routes during the period.

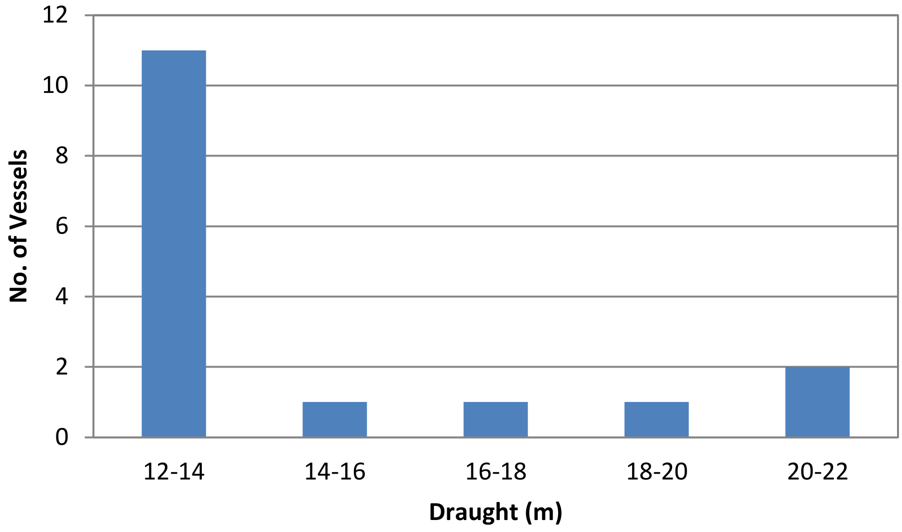


Figure 10.4 Large Tanker Draught Distribution (Four Months - March to July 2015)

10.4 Passenger Vessels

Passenger vessels recorded during the combined 28 days of surveying are presented in Figure 10.5.

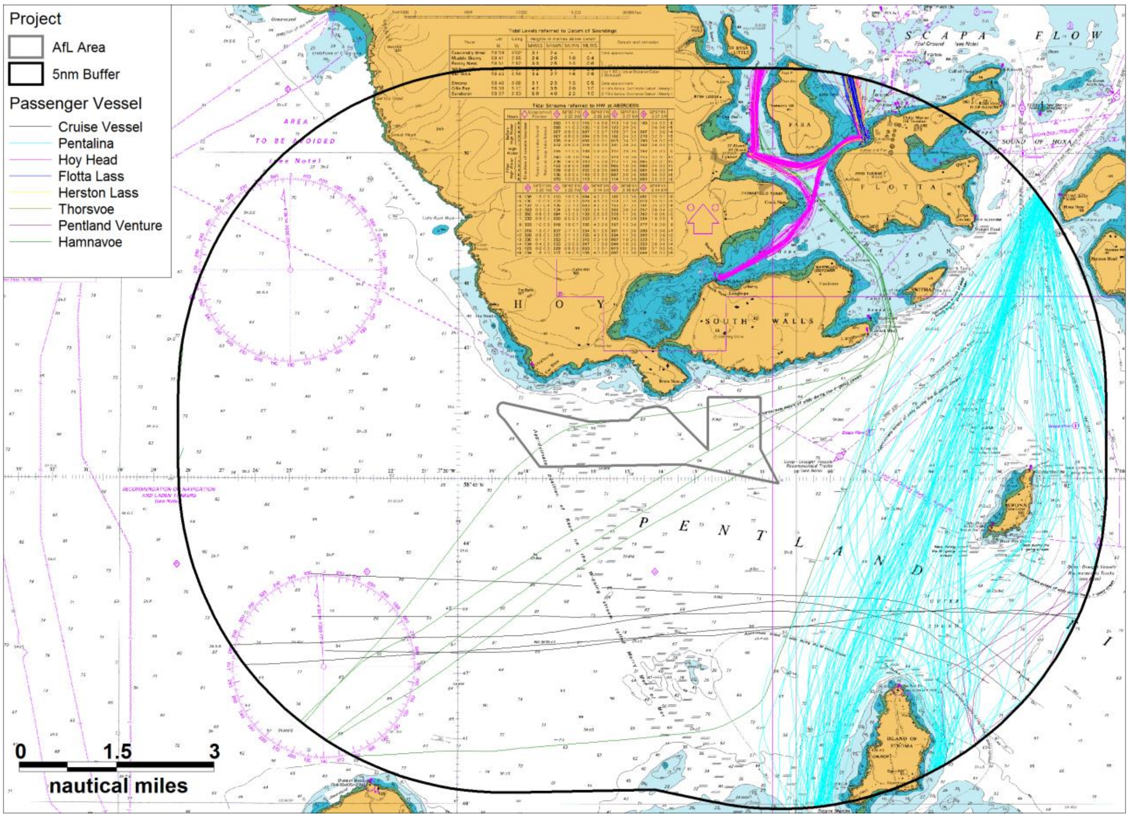


Figure 10.5 Passenger Vessel AIS and Radar Data (28 Days) within 5nm Buffer

Serco NorthLink's vessel *Hamnavoe*, which travels between Scrabster and Stromness, was the only passenger vessel which transited through the AfL area, doing so four times when transiting northbound during periods of bad weather in the winter 2013 survey via Cantick Sound rather than the normal route west of Hoy. Figure 10.6 presents a photograph of this vessel, taken during the winter 2013 survey.

Figure 10.6 Photograph of Serco NorthLink *Hamnavoe* on 27 November 2013

Figure 10.7 presents additional analysis of tracks of *Hamnavoe*, from the 2010 PHA AIS data, as a more diverse range of passages was made by *Hamnavoe* during this period.

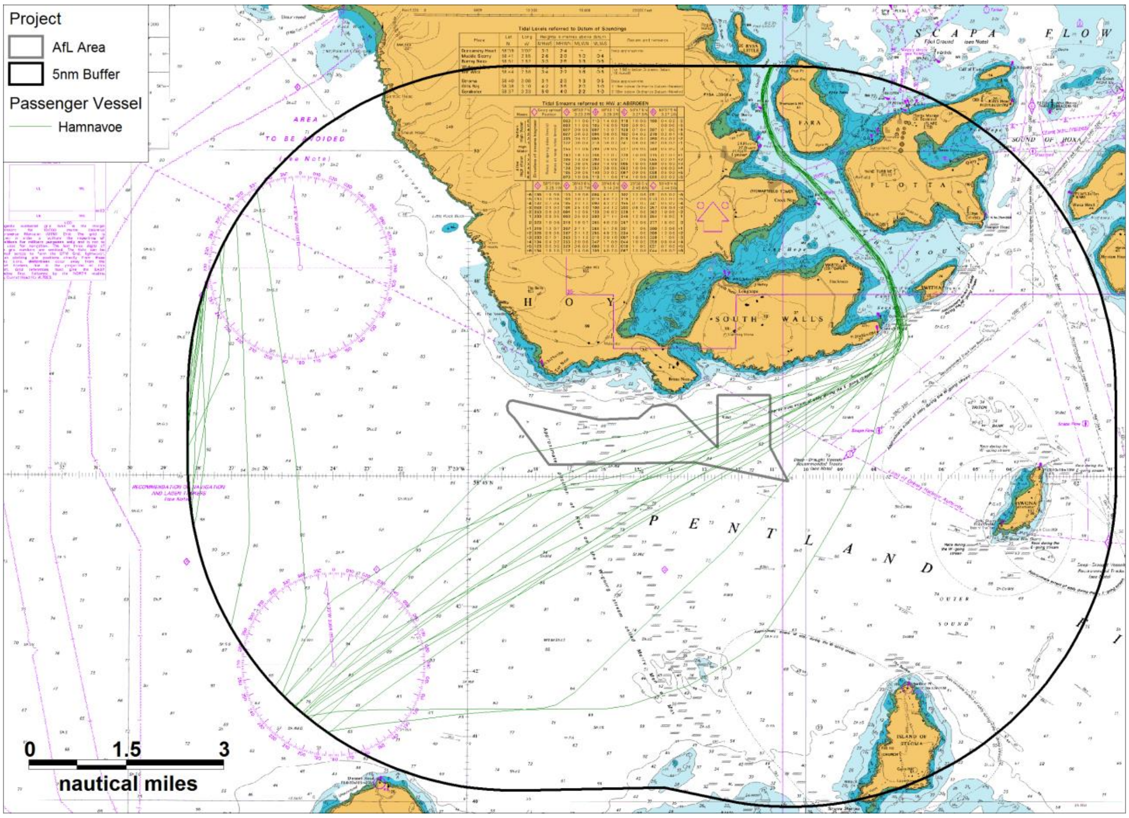


Figure 10.7 ***Hamnavoe*** **AIS Data (56 Days Summer and Winter 2010) within 5nm Buffer**

Fourteen tracks were recorded through the AfL area during the 56 days 2010 data, all during winter 2010.

The *Pentalina* is Pentland Ferries' passenger vessel, linking Gills Bay and St. Margaret's Hope. This vessel passed a minimum of 1nm from the AfL area when routeing west of Stroma and was recorded in both survey periods.

In the summer 2014 survey only, *Pentland Venture* was tracked regularly between John o'Groats and Burwick, with the closest transit to the AfL area 4.2nm to the southeast.

Finally, four cruise vessels were recorded in the summer data, the closest passage to the AfL area made at a distance of 1.7nm.

10.5 Military Vessels

Figure 10.8 presents a chart of the military vessels tracked within the 5nm buffer during the 28 days survey.

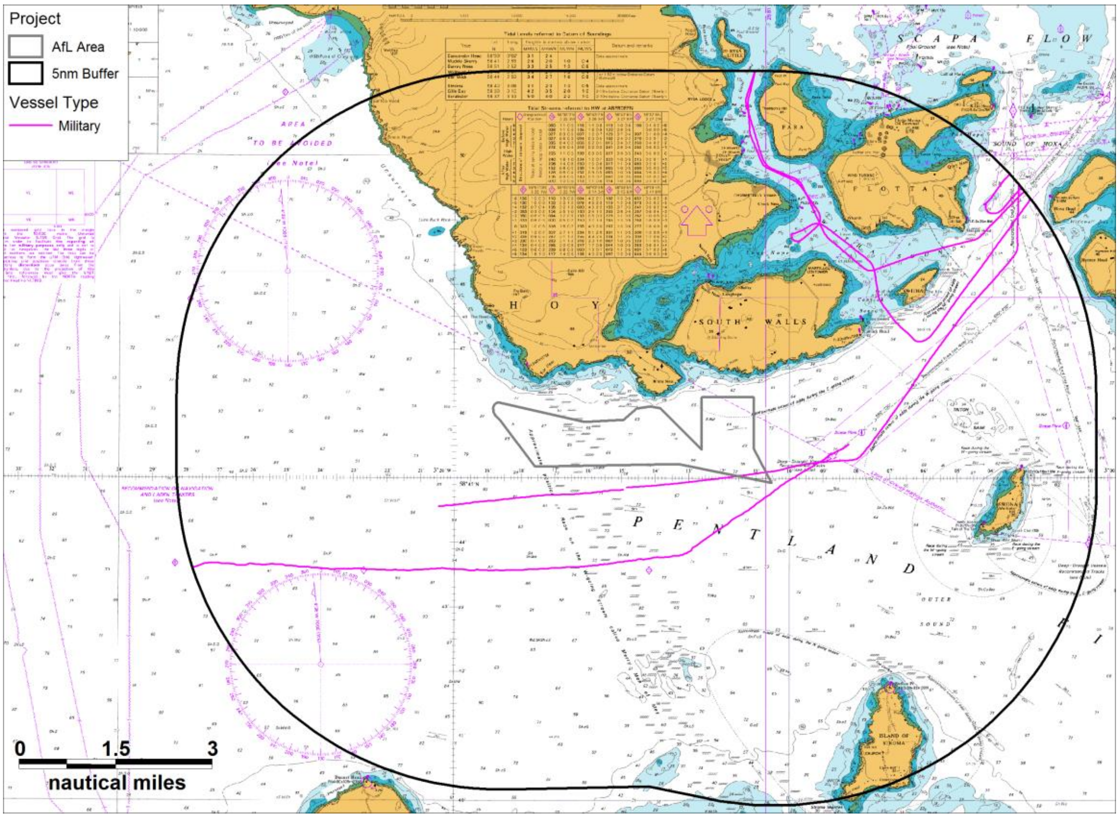


Figure 10.8 Military Vessel AIS and Radar Data (28 Days) within 5nm Buffer

One military vessel, *HMS Northumberland*, was recorded in the 5nm buffer, also intersecting the southeast corner of the AfL area, in the winter 2013 survey (no military vessels were tracked during the summer 2014 survey). The Ministry of Defence (MoD) was consulted on the Project and indicated that there were no objections.

10.6 Other Vessels

Figure 10.9 presents a chart of other vessels recorded in the 5nm buffer during the 28 days survey.

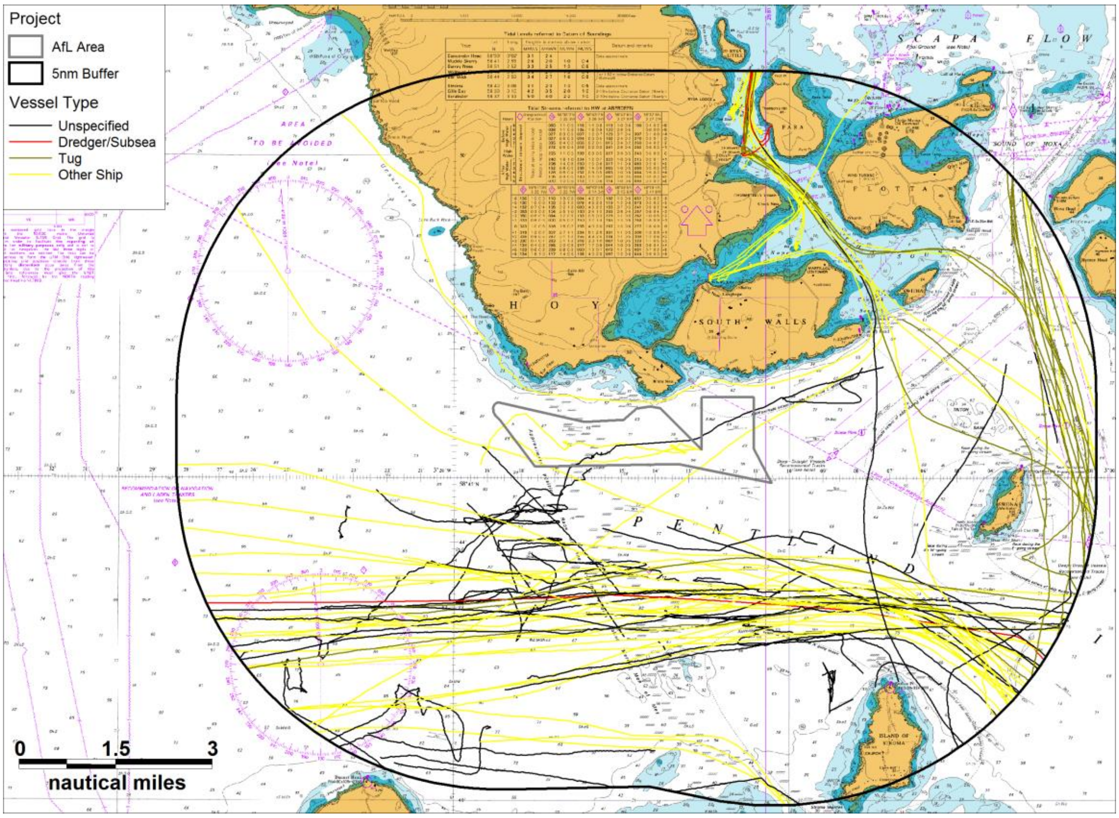


Figure 10.9 Other Vessel AIS and Radar Data (28 Days) within 5nm Buffer

There were three ‘other’ vessels recorded within the AfL area, all during the winter 2013 period. These were the recreational sea angling charter vessel *Welcome Home* based in Stromness, the Fisheries patrol vessel *Hirta* and a multipurpose support vessel *Helen Burnie*.

Unspecified vessels were non-AIS targets that could not be visually identified due to poor visibility or darkness when they were recorded. One unidentified vessel passed through the AfL area.

11. FISHING VESSEL ACTIVITY

11.1 Introduction

This section reviews the fishing vessel activity in the vicinity of the Brims Tidal Array based on the maritime traffic survey, the latest available surveillance data (sightings and satellite), the Commercial Fisheries Technical Report, and consultation with local fishing stakeholders.

11.2 Survey Data

At the time of the winter 2013 survey, AIS carriage was mandatory for fishing vessels ≥ 18m length under EU Directive. This extended to 15-18m vessels at the time of the summer survey. A proportion of smaller fishing vessels also carry AIS voluntarily but may not broadcast continuously.

Figure 11.1 presents fishing vessels recorded on AIS and radar in the 5nm buffer, for the combined winter and summer period.

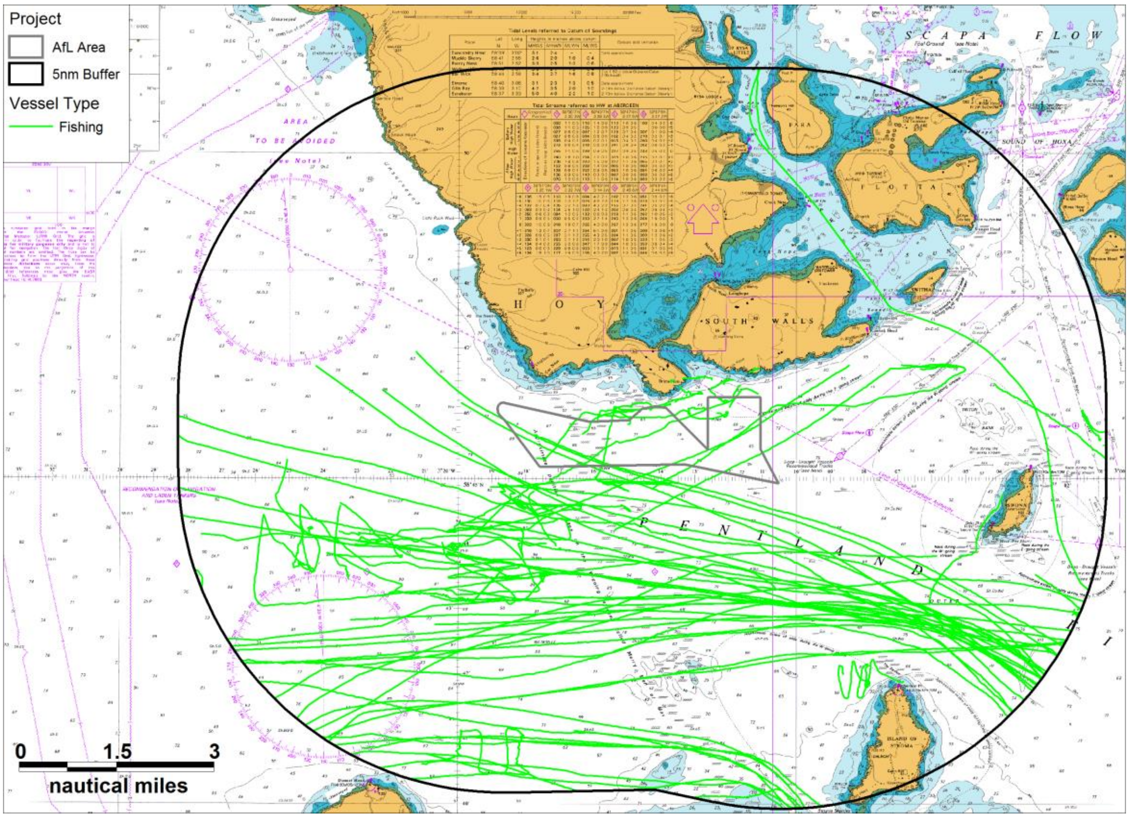


Figure 11.1 Fishing Vessel AIS and Radar Data (28 Days) within 5nm Buffer

Figure 11.2 presents the fishing vessel tracks in proximity to the AfL area.

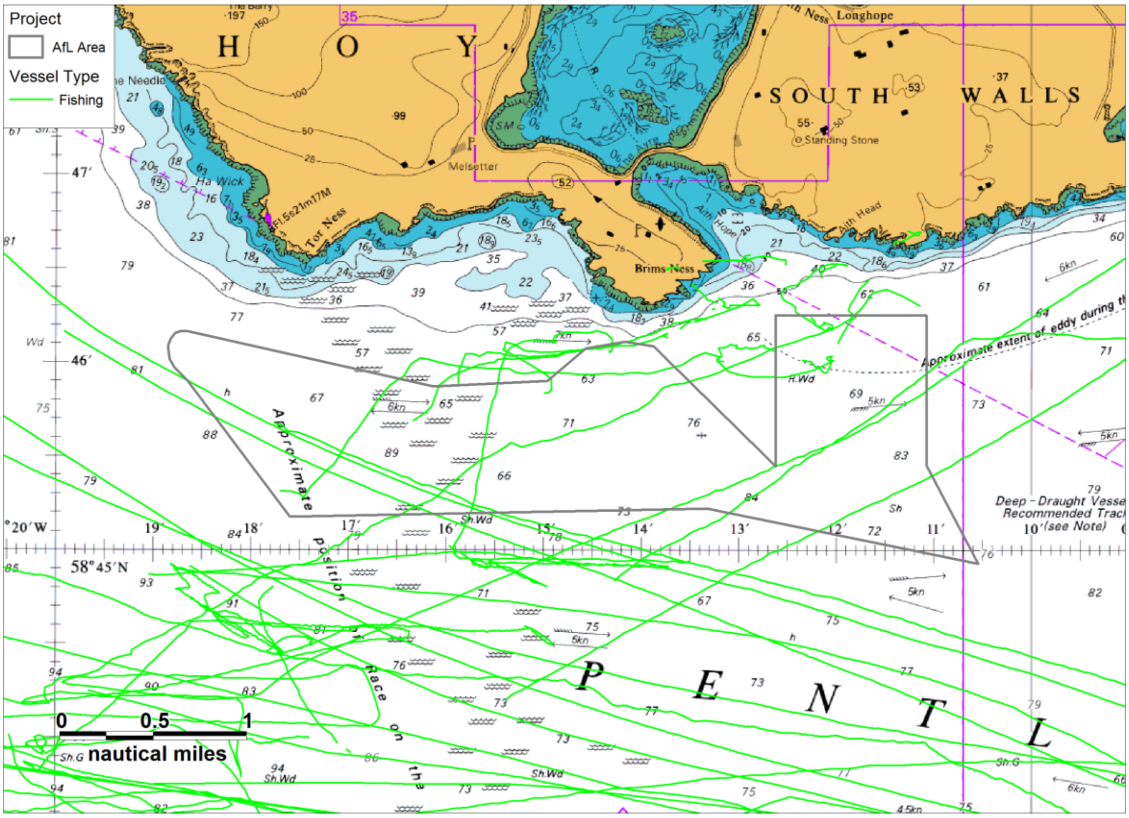


Figure 11.2 Fishing Vessel AIS and Radar Data (28 Days) in proximity to AfL Area

Fishing vessels within the AfL area were all recorded on radar. The majority of fishing vessels tracked passing within the AfL area in winter 2013 were steaming. *Caspian* was seen on two separate occasions, including once hauling pots on the eastern edge of the site. Other vessels identified in the winter 2013 survey included the *Guiding Light* (twice) and the *Samantha Jane*.

During the summer 2014 period, all fishing vessels observed within the AfL area were steaming. *Samantha Jane* was the most frequently recorded, transiting the site on three occasions. *Kristrun II RE 477*, *Endurance FR111*, *Caspian*, *Guiding Light* and the unidentified '*RV87 Red Hulled White Wheelhouse*' were all recorded once. *Caspian* and *Samantha Jane* were both seen hauling pots between the site and the Brims Ness shore three times and once, respectively.

In addition to the fishing vessels recorded on AIS and radar, there were manual sightings of fishing vessels. Full details of these are presented in Section 9.9. Fishing vessel *Caspian* was recorded 16 times during the winter 2013 survey. The vessel moored in Aith Hope at night and went to Aith Head for fishing operations during the day. It was seen transiting towards Tor Ness on two occasions. *Guiding Light* was observed twice, mooring in Aith Hope on 23 November and leaving its mooring on 25 November. An unidentified fishing vessel was recorded twice, to the west of the AfL area. Manual observations during the summer 2014 survey were of *Caspian*, seen hauling creels three times. *Guiding Light* was seen three times, steaming through the AfL area and fishing west of Hoy. *Samantha Jane* was recorded twice, once engaging in fishing and once steaming. *Skua*, a small angling vessel, was seen engaging in fishing. Figure 11.3 to Figure 11.6 present photographs of fishing vessels observed during the surveys.

Figure 11.3 Photograph of *Guiding Light* on 23 November 2013

Figure 11.4 Photograph of *Caspian* in Winter 2013

Figure 11.5 Photograph of *RV87* on 1 June 2014

Figure 11.6 Photograph of *Samantha Jane* on 6 June 2014

11.3 Surveillance Data – Geographical Division

Fisheries statistics in the UK are reported by ICES statistical Rectangles and Subsquares. The AfL area is located within ICES Rectangle 46E6 Subsquare 46E6/2, as shown in Figure 11.7.

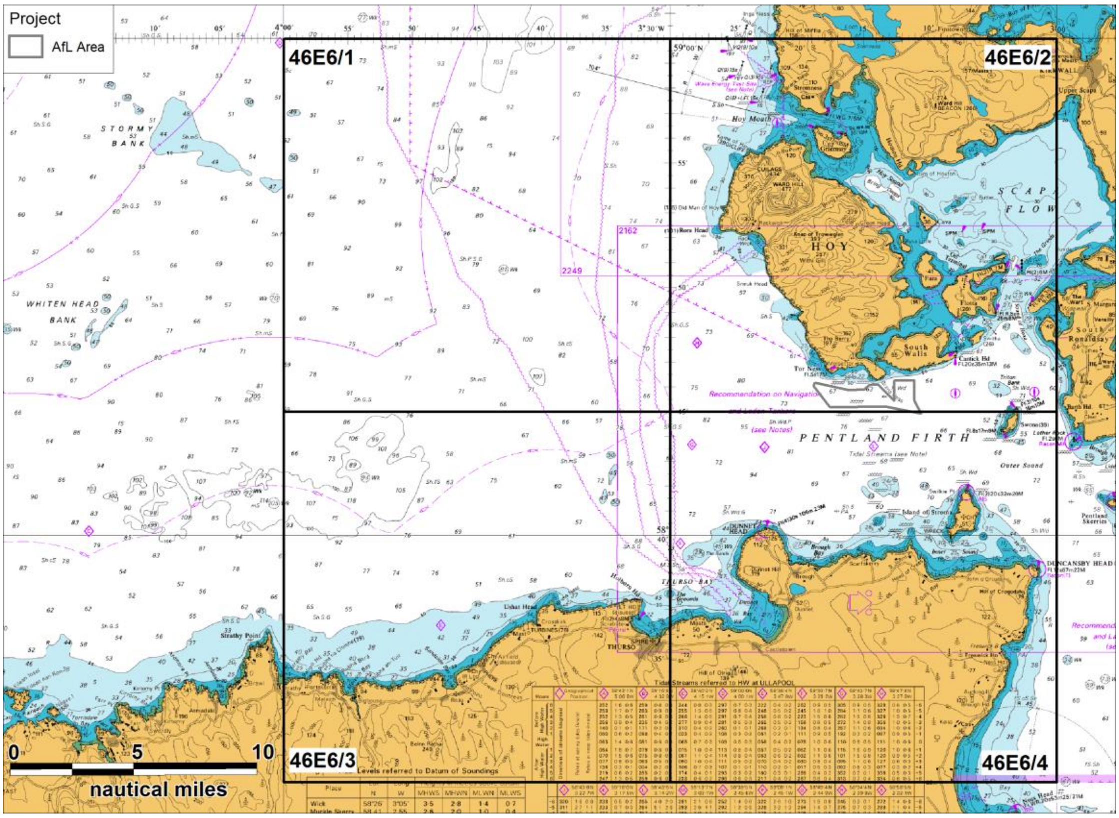


Figure 11.7 ICES Subsquares in the vicinity of the AfL Area

11.4 Sightings Data

Data on fishing vessel sightings were obtained from Marine Scotland Compliance who monitors the fishing industry in Scottish waters through the deployment of patrol vessels and surveillance aircraft.

Each patrol logs the positions and details of fishing vessels within the Rectangle being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their PLN. Records of the number of patrols are no longer available.

The sightings data from three years (2012-2014) were imported into a GIS for mapping and analysis. The fishing vessel sightings thematically mapped by nationality are presented in Figure 11.8.

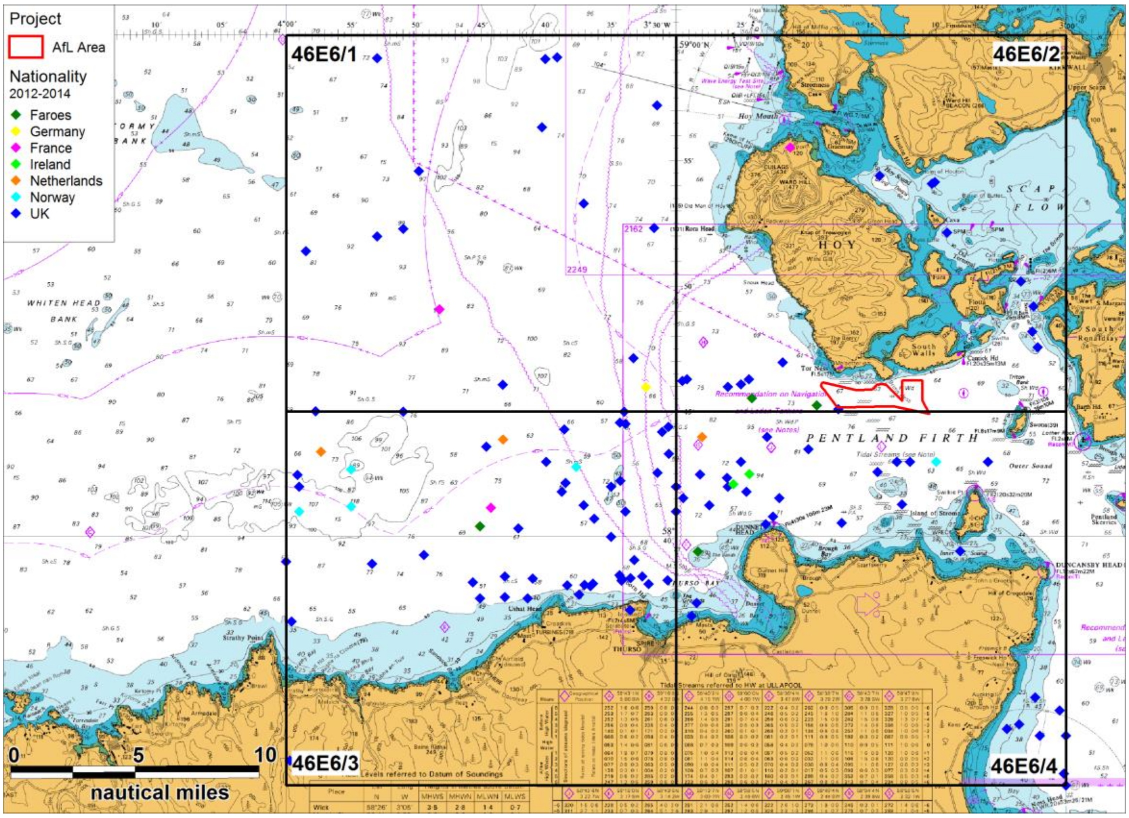


Figure 11.8 Fishing Vessel Sightings by Nationality

The majority (86%) of fishing vessels were UK registered. No sightings were recorded within the AfL area.

The fishing vessel sightings thematically mapped by gear type are presented in Figure 11.9.

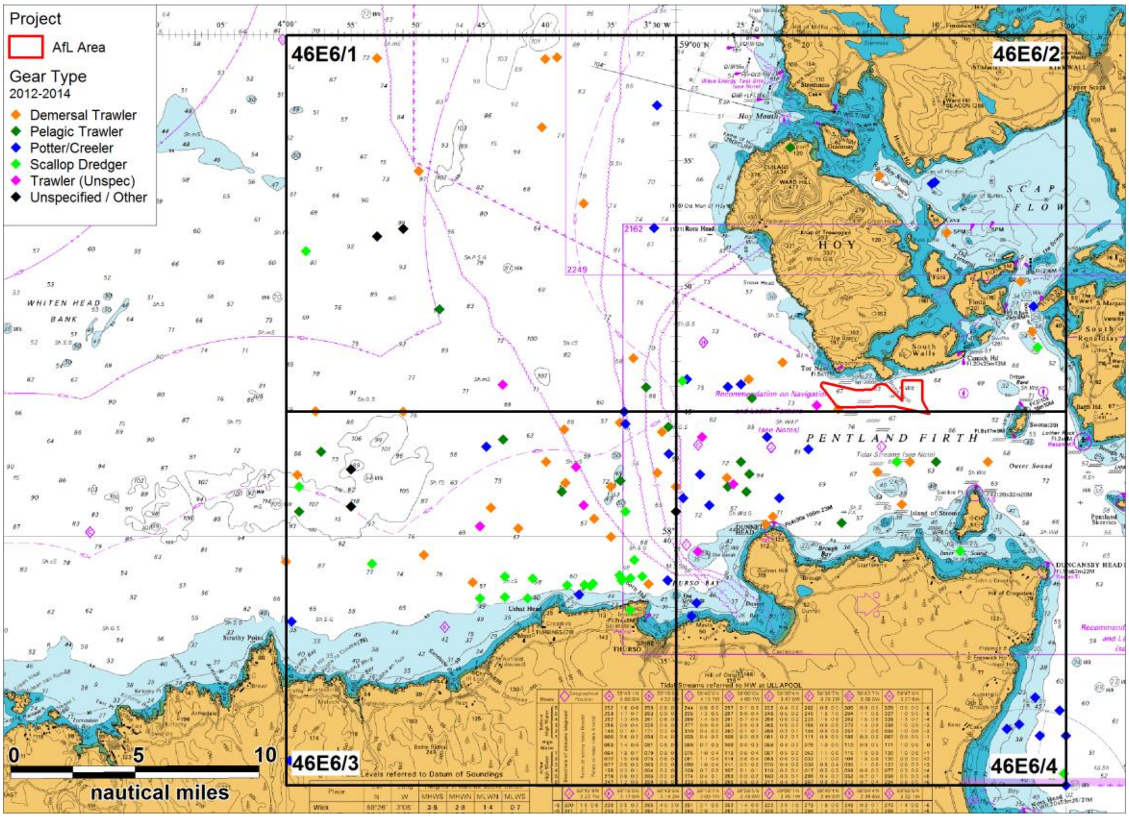


Figure 11.9 Fishing Vessel Sightings by Type

The main fishing methods were demersal trawling (32%), potter / creeler (24%) and scallop dredger (21%).

Fishing vessels thematically mapped by activity when sighted are presented in Figure 11.10.

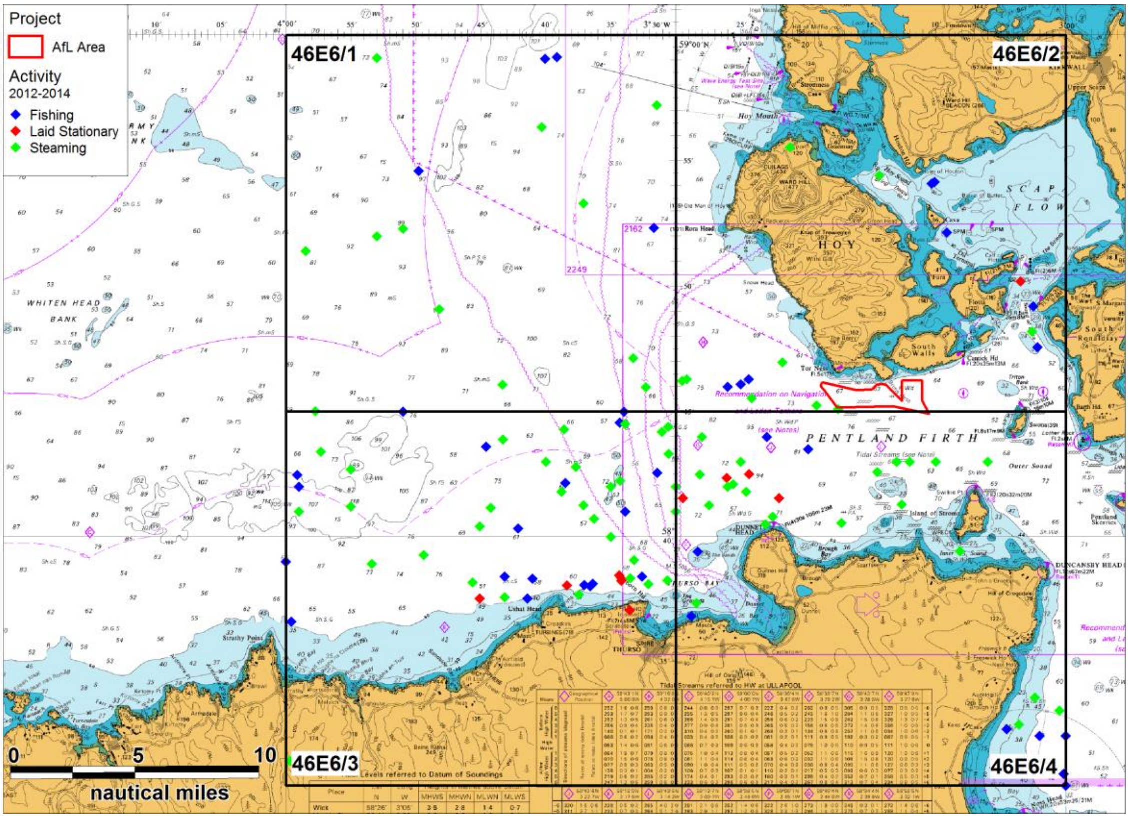


Figure 11.10 Fishing Vessel Sightings by Activity

Over half (60%) of the vessels sighted were steaming (transiting to / from fishing grounds), and 30% were engaged in fishing, i.e., gear deployed.

The lengths of vessels sighted in ICES Rectangle 46E6 are summarised in Figure 11.11.

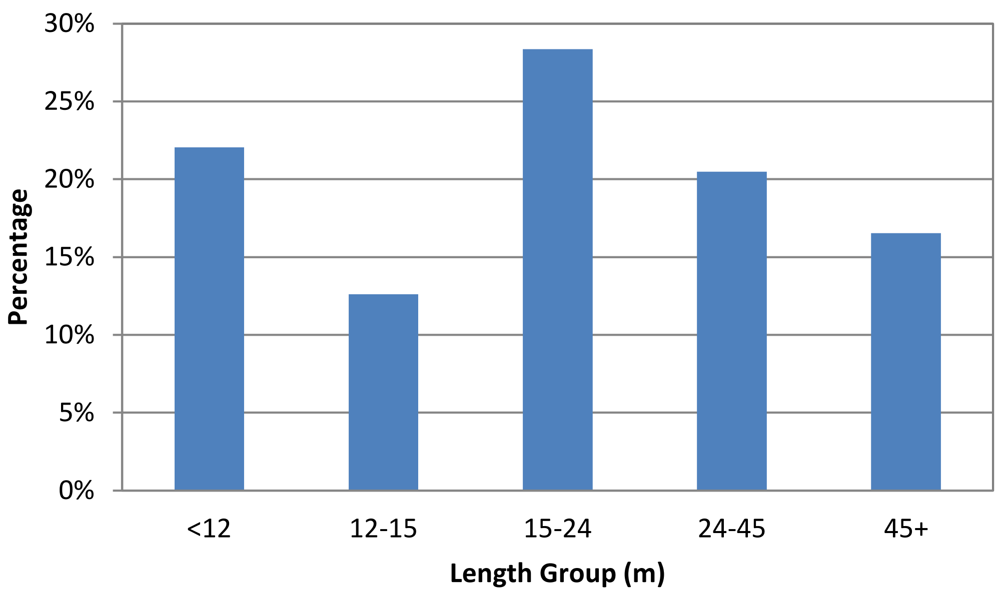


Figure 11.11 Fishing Vessel Sightings by Length Group (2012-14)

Thirty-five percent of vessels were below 15m in length, which is the current limit for AIS carriage on fishing vessels.

11.5 Satellite Data

The MMO operates a satellite-based vessel monitoring system. The vessel monitoring system is used, as part of the sea fisheries enforcement programme, to track the positions of fishing vessels of 15m length and over in UK waters. It is also used to track all UK registered fishing vessels globally. In Scottish waters the system is managed by Marine Scotland Compliance.

Vessel position reports are typically received every 1-2 hours. The data covers all EC countries within British Fisheries Limits and certain Third Countries, e.g., Norway and Faeroes. Vessels used exclusively for aquaculture and operating exclusively within baselines are exempt.

Satellite data obtained from Marine Scotland Compliance for 2012-2014, which includes both UK and non-UK vessels, is presented in Figure 11.12 and Figure 11.13, thematically mapped by nationality and speed.

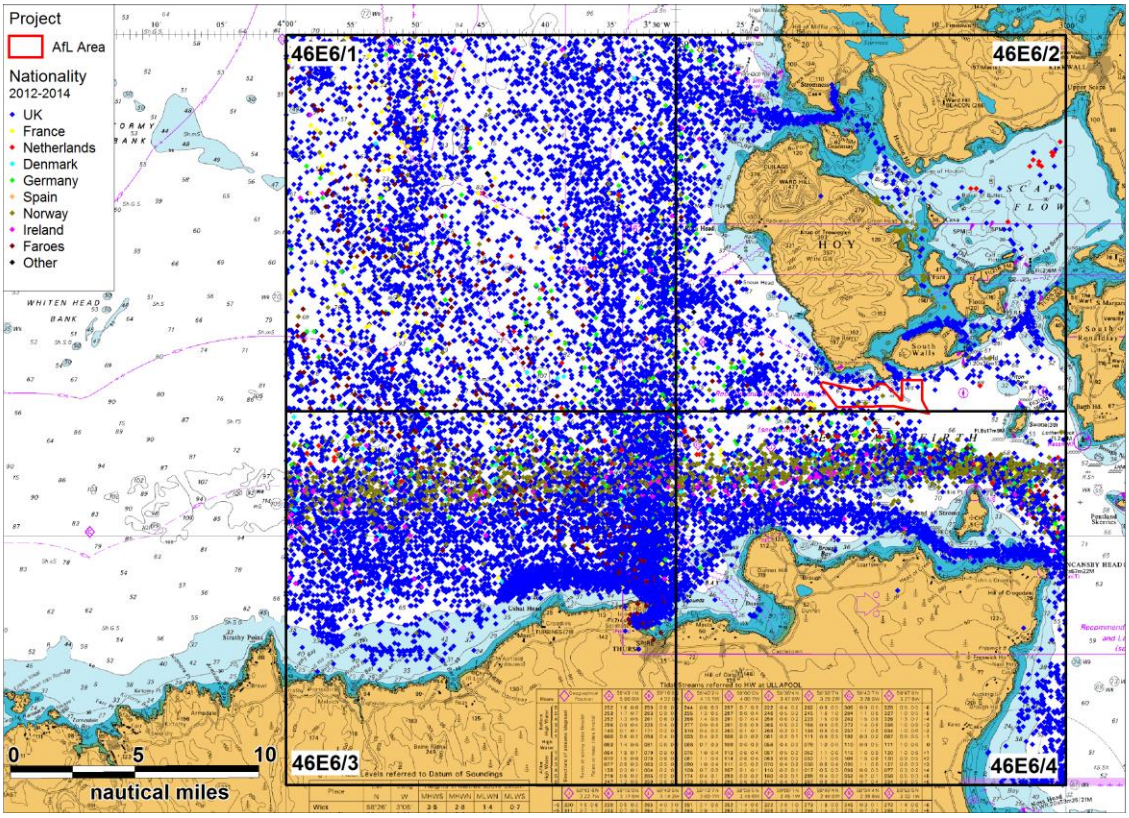


Figure 11.12 Fishing Vessel Satellite Positions by Nationality

Overall, the majority of fishing vessels tracked by satellite in the ICES Subsquares (93%) were registered in the United Kingdom. Other countries present included Norway, the Faroe Islands, France, Germany and Ireland.

Within the AfL area, 90% of vessels were UK-registered, with the remaining 10% registered in Norway.

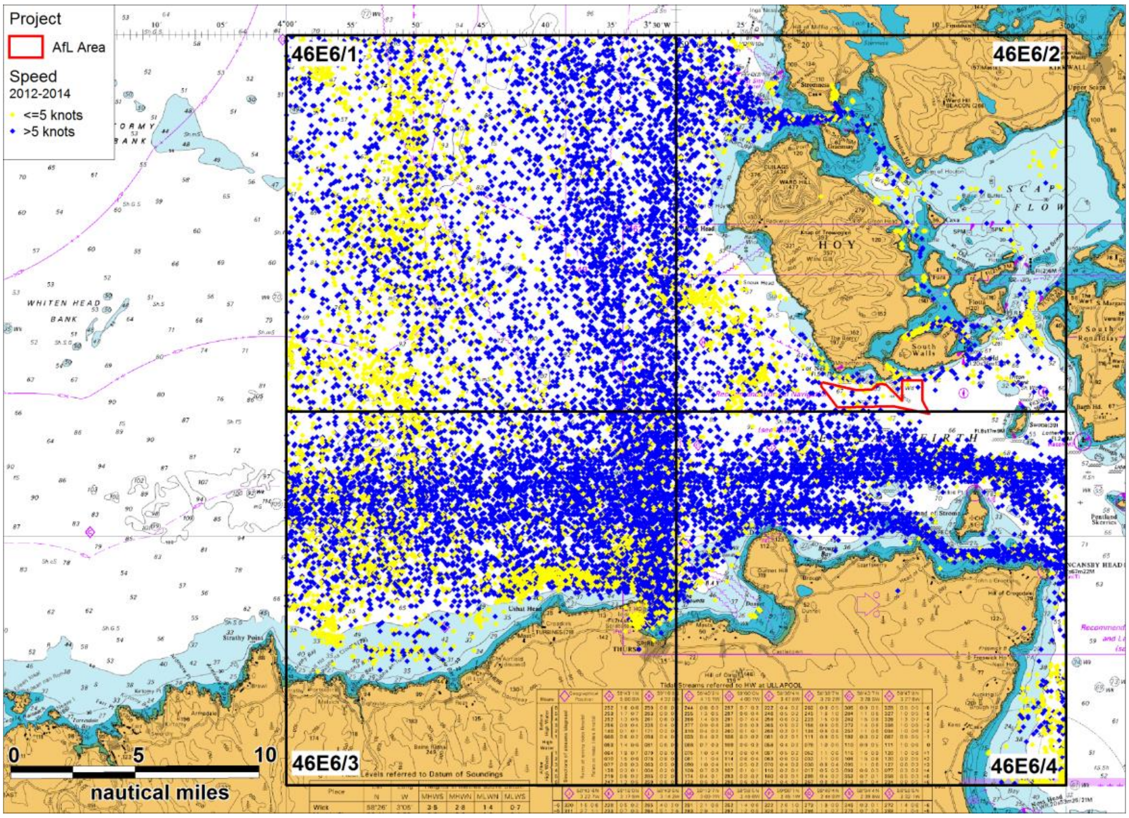


Figure 11.13 Fishing Vessel Satellite Positions by Speed

Approximately 80% of vessels were tracked within the ICES Subsquares at speeds below 5 knots and may have been engaged in fishing but more likely traveling at low speeds near the coast.

Within the AfL area, approximately 55% of vessel positions were at speeds above 5 knots and hence likely to be steaming on passage through the AfL area. The remaining 45% were travelling at speeds below 5 knots and hence may have been engaged in fishing.

11.6 Crown Estate Succorfish Data

Orkney Sustainable Fisheries Ltd (OSF) and TCE developed a programme of work for collecting data for a dynamic description of inshore fishery patterns to best serve the planning, consenting and regulatory needs of the marine energy industry in the Pentland Firth and Orkney Waters (PFOW) region.

The data describe the spatial distribution of the Orkney creel fishery. Twenty Orkney-based creel vessels have been equipped with a Succorfish electronic navigation system. This system is a combination of satellite and GPRS. Further analysis of Succorfish data, covering a greater temporal extent, is presented in the Commercial fisheries chapter of the ES.

Figure 11.12, presents the Succorfish data, for the period October to December 2014, in the vicinity of the AfL area, thematically mapped by vessel speed.

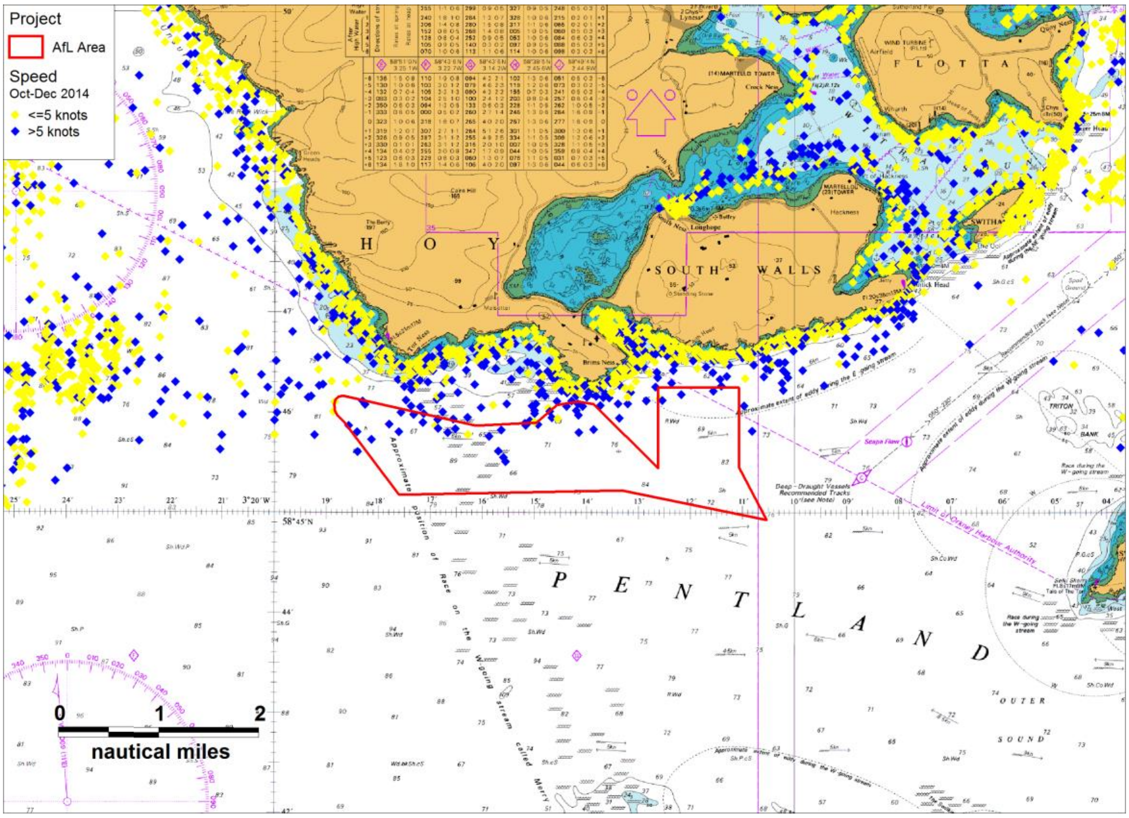


Figure 11.14 Fishing Vessel Succorfish Positions by Speed

The data show a number of fishing vessel positions in the near-shore area of the AfL area. These were recorded as both above and below 5 knots and hence likely to include vessels steaming on passage and engaged in fishing.

Thirty-six vessel positions were recorded within the AfL area, with approximately 10% of these vessels recorded as below 5 knots.

The data for October to December 2014 show a slightly wider spatial distribution within the AfL area than the extended dataset from April 2013 to March 2015, which is presented and analysed in the Commercial fisheries ES chapter.

11.7 Commercial Fisheries Technical Report

The Commercial Fisheries chapter of the ES describes fishing activity in the vicinity of the Project. The research used MMO landings values and effort (2009-2013), Marine Scotland landings value and liveweight (2009-2013), Scotmap spatial data (2014), Marine Scotland seasonal landings of primary target species (2009-2013), and Succorfish spatial data (2013-2014). The study areas used were a 12nm buffer surrounding the AfL area for mobile gears, and a 600m buffer of the AfL area and cable route corridors for static gears.

Data indicate that fishing effort and value of landings in the study area varies, and is negligible in the vicinity of the AfL area compared to other areas within the study area. This general fishing pattern was also confirmed during consultation with the Scottish Fishermen's Federation (SFF) and the Scottish Pelagic Fishermen's Association (SPFA). Scotmap data prove the importance of the inshore areas of the export cable corridor. Data from consultation with fishermen corroborates the Scotmap data which also indicate the most prominent gear used in the study area is static gear for crab and lobster. In ICES Rectangle 46E6, the shellfish fishery is largest in terms of both economic value and liveweight. The top five species landings values are as follows:

- Edible (brown) crab and lobster dominate the landings in ICES rectangle 46E6 across all vessel sizes, both separately accounting for 22% of the total value of landings and 29% and 3% of the liveweight landed respectively. ScotMap data corroborates this, which highlights the use of pots and creels as dominant in the Study area.
- Herring are targeted by pelagic gear and account for 25% of landed weight, but only 7% of value landed.
- Monkfish, typically targeted by demersal trawlers, accounts for 12% of value and 6% of landed weight from ICES rectangle 46E6.
- Scallops are caught with mobile gear in the 12nm study area (although diving is common elsewhere in Orkney) and comprise 8% of the value of landings and 5% of landed weight from ICES rectangle 46E6.

In terms of key ports and vessel numbers, Longhope is the only harbour of interest to vessels fishing in the vicinity of the AfL area. There are four vessels registered in this harbour, below 10m in length, and one vessel over 12m in length.

Within the study area the fisheries most likely to be affected by the proposed development are the crab and lobster fisheries. Fishing effort and fishing vessel presence is greater in the cable route corridors than in the Phase 1 or Phase 1 & 2 Project areas.

11.8 Consultation

Local fishermen and their representatives (e.g., Orkney Fisheries Association) as well as the Kirkwall Fisheries Officer were invited to the Hazard Review Workshop. This was used to confirm that fishing in the site is limited to a handful of local vessels using static gear, with fishing vessels using mobile gear highly unlikely to fish in this area.

Feedback from Marine Scotland Science in the PBD response in May 2012 indicated that the majority of demersal vessels in the area are unlikely to be fishing and most are likely to be transiting through the Pentland Firth. This was confirmed at a meeting in June 2015 with the SFF and SPFA. It was also confirmed at this meeting that the minimum under water clearance of 20m below LAT (as proposed at the time of the meeting, now increased to 30m) should be ample for all fishing vessels in all conditions. Fishing vessels only tend to clip the southwest corner of the AfL area (if at all) when rounding Hoy, transiting to / from west Orkney so there should not be a significant issue even for construction or maintenance activity on site.

Other fisheries consultation is summarised in Section 13 and Appendix A. Local consultation with fisheries stakeholders also took place as part of the Commercial Fisheries work, referenced above.

12. RECREATIONAL VESSEL ACTIVITY

12.1 Introduction

This section reviews recreational vessel activity in the vicinity of the Brims Tidal Array based on the traffic survey, desktop information, and consultation with local recreational stakeholders.

12.2 RYA Data

The RYA, supported by the CA, has identified recreational cruising routes, general sailing and racing areas in the UK. This work was based on extensive consultation and qualitative data collection from RYA and CA members, through the organisations' specialist and regional committees and through the RYA affiliated clubs. The consultation was also sent to berth holder associations and marinas.

The results of this work were published in Sharing the Wind (RYA, 2004) and updated GIS layers published in the Coastal Atlas (RYA, 2009).

An overview followed by a more detailed plot of the recreational sailing activity and facilities identified in the RYA dataset, in the area surrounding the Brims Tidal Array is presented in Figure 12.1.From local knowledge it is known that there are also racing areas for local regattas at Holm and Longhope, which are not represented within the RYA dataset.

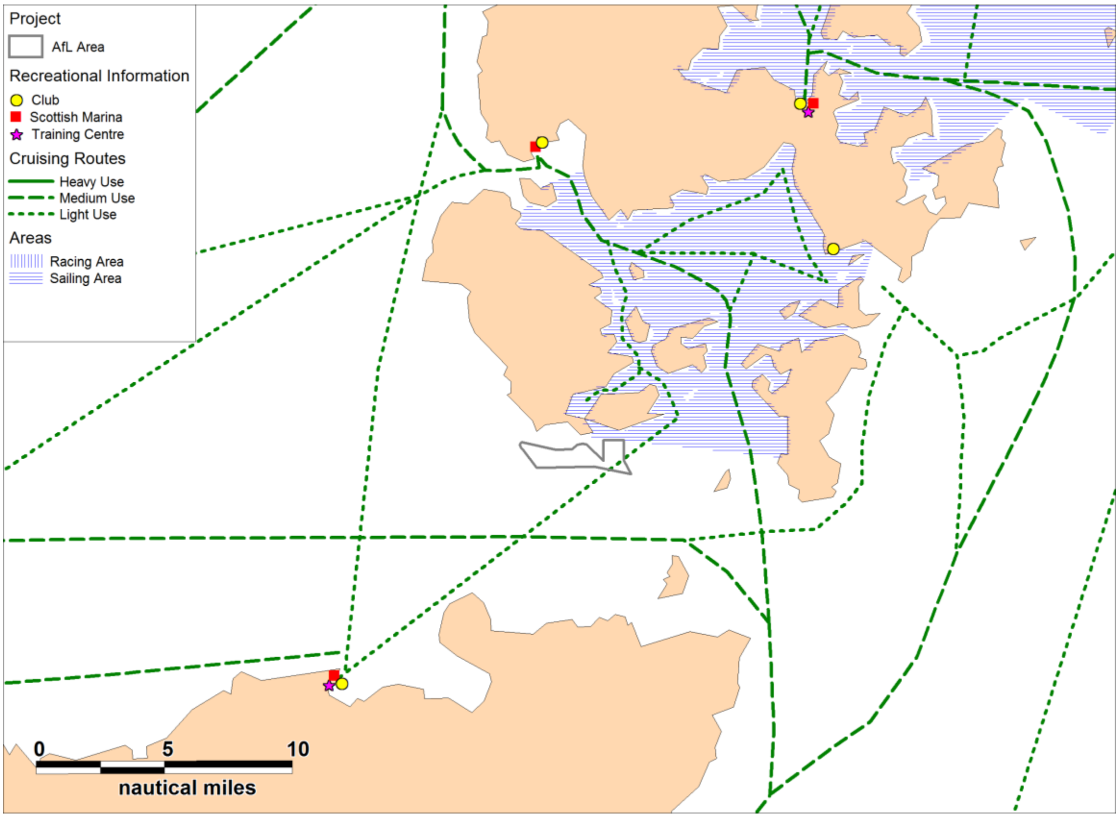


Figure 12.1 Recreational Data for North East Scotland Strategic Area

Recreational boating, both under sail and power is highly seasonal and highly diurnal. The division of recreational craft routes into Heavy, Medium and Light Use is therefore based on the following classification:

- Heavy Recreational Routes: - Very popular routes on which a minimum of six or more recreational vessels will probably be seen at all times during summer daylight hours. These also include the entrances to harbours, anchorages and places of refuge.
- Medium Recreational Routes: - Popular routes on which some recreational craft will be seen at most times during summer daylight hours.
- Light Recreational Routes: - Routes known to be in common use but which do not qualify for medium or heavy classification.

Based on the published data, the AfL area lies in close proximity of the North East Scotland Sailing Area and outside of general racing areas identified by the RYA. A light-use cruising route passes through the east part of the AfL area, running between Scrabster Harbour and various routes in the vicinity of Orkney.

In terms of facilities, the nearest club and training centre (by sea) is the Pentland Firth Yacht Club, approximately 22nm southwest of the AfL area at Scrabster, and the closest marina is Scrabster Harbour.

It should be noted the routes are indicative and the RYA is updating the data as more information becomes available.

12.3 Marine Scotland Shipping Study

Marine Scotland carried out a shipping study of the Pentland Firth and Orkney Waters (Marine Scotland, 2012) which RYA Scotland was heavily involved in.

Figure 12.2 presents recreational vessel activity findings for this study, in the vicinity of the AfL area.

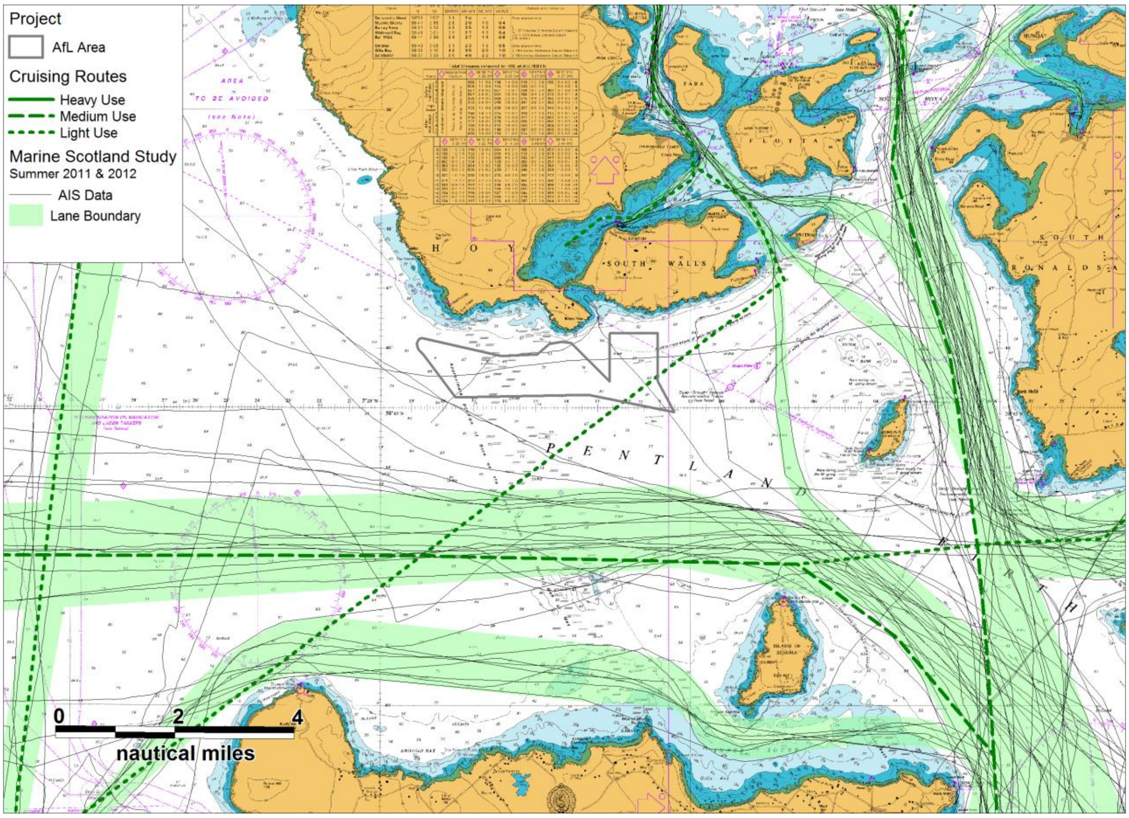


Figure 12.2 Marine Scotland Shipping Study of the Pentland Firth and Orkney Waters Recreational Data

Five months' AIS data for summer 2011 and summer 2012 were used in the assessment. AIS survey data were compared with recreational cruising routes from the RYA Coastal Atlas. In addition to this, 90% lane boundaries (i.e. the width within which 90% of the traffic passes on that route) were also analysed.

Within this study, it was identified that there is a low density of recreational activity in the vicinity of the Brims Tidal Array AfL area and that the RYA light-use cruising route which passes through the AfL area is rarely used. The Marine Scotland study identified one anchorage area in use by recreational vessels, in Aith Hope to the north of the AfL area.

12.4 Survey Data

Figure 12.3 presents the recreational vessel tracks identified from the AIS and radar surveys within the 5nm buffer of the AfL area.

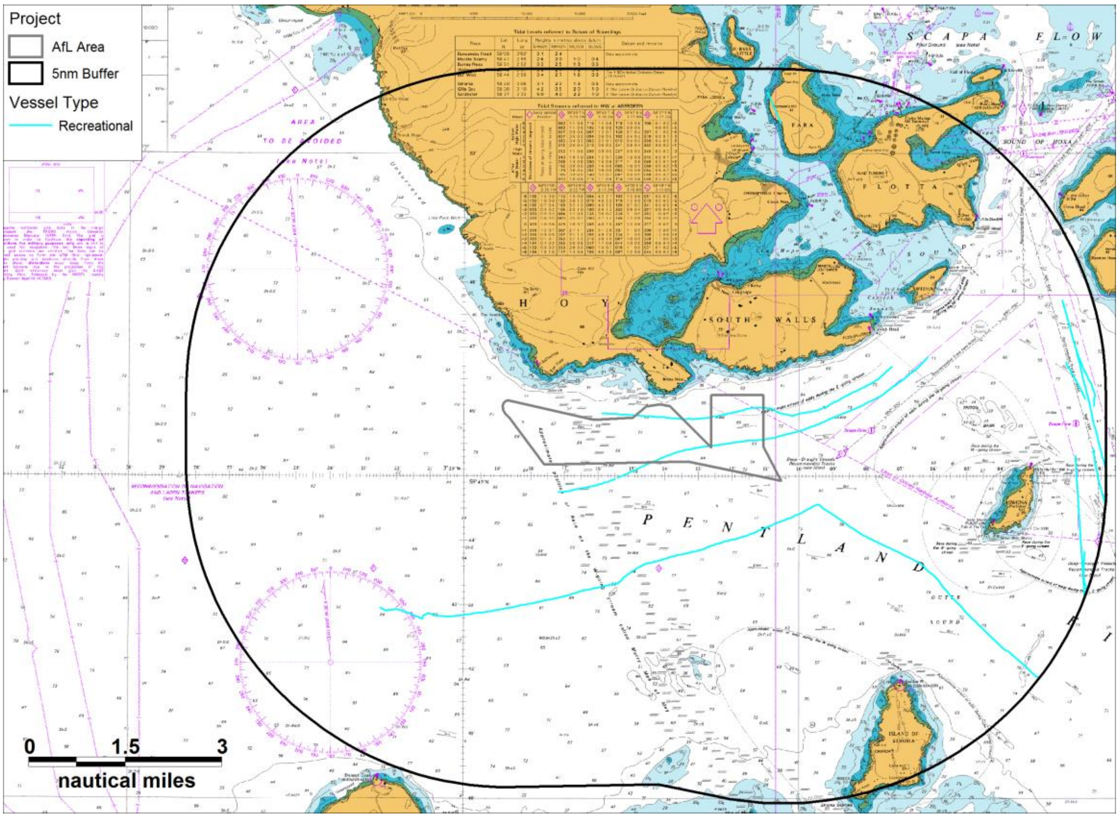


Figure 12.3 Recreational Vessel AIS and Radar Data (28 Days) within 5nm Buffer

There were nine recreational vessels tracked during the summer 2014 survey period, with no recreational vessels identified during the winter 2013 survey. Two sailing vessels, *Zuza* (presented in Figure 12.4) and *Coast Inn*, were recorded within the AfL area, both travelling northeast towards Scapa Flow. The majority of the recreational vessels were tracked entering or leaving Scapa Flow, to the east of the AfL area.

Figure 12.4 Photograph of *Zuza* on 9 June 2014

12.5 Clyde Cruising Club Sailing Directions

The Clyde Cruising Club produces Sailing Directions for various areas of Scotland. The publication covering Orkney Waters (Clyde Cruising Club Publications, 2010), which was complied with local knowledge, includes information for recreational sailors using the Pentland Firth and Scapa Flow areas.

12.5.1 Wick to Long Hope

The tide turns northwest off Duncansby Head -0105 (+0115 Dover). Departure should be timed from Wick to reach point 1nm east of Duncansby Head at slack water.

i. With a west wind less than a force 4, the passage can be safely made. A good course should be made for Lother Rock and the west-going ebb from north of Muckle Skerry should be picked up. Passage should be made north of Switha.

ii. With an east wind, the directions above should be followed, but Little Skerry should be steered towards. Passage should be made close west of Muckle Skerry, then the above should be followed again. It must be remembered that the ebb tide sets west towards Swona and, if it is likely to be difficult to clear the north end of Swona, this must be realised early and Swona passed to the south well clear of Tarf Tail. In general, when 2 cables north of Clett of Swona one will be in the northwest-going ebb stream.

12.5.2 Long Hope to Wick

The east-going stream along the south coast of South Walls begins +0435 Aberdeen (-0530 Dover), and in Outer Sound between Swona and Stroma at +0505 Aberdeen (-0500 Dover). The last of the inshore west-going stream stops in mid-firth. On passing Cantick Head light house heading south, the lighthouse should be kept 2 cables off until it is abeam to westward. The last of the inshore ebb (west-going) stream should be used to reach Aith Hope. The main flood in the Outer Sound should be waited for. Almost due south should then be steered for to ensure passing through the Outer Sound in mid-channel. Southeast should be headed for to pass mid-way between Duncansby Head and the Pentland Skerries to avoid Duncansby Race which forms on the flood and extends 1nm offshore.

12.5.3 Scapa Flow

It is necessary to keep aware of inter-island and mainland ferry traffic. Anchorage can be found in the southwest approach, in Aith Hope which is entered between Brims Head and Aith Head. Shelter can be found in depths of 4-11m in sand off the former Longhope Lifeboat Station. The Ayre is an artificial causeway linking Hoy to South Walls.

12.6 Orkney Marinas Sailing Directions

The Orkney Marinas website provides sailing guides for Orkney waters. While there are no sailing guides or GIS files which cover the Pentland Firth, the website provides a general overview of sailing in the vicinity of the AfL area. Relevant information is presented below.

12.6.1 Sailing to and from Orkney

The major consideration when sailing to Scapa Flow from the south is crossing the Pentland Firth. When sailing to Scapa Flow from the west, the timing of entry to Hoy Sound is important.

12.6.2 Crossing the Pentland Firth to Orkney from the South

This covers heading to Scapa Flow and Stromness from the south. When crossing the Pentland Firth, avoid strong (force 6 and above) wind against tide conditions and plan use of tides carefully. Spring tides can run at very high rates, as noted in the tidal atlas. If possible, aim to transit with neap tides if any significant wind is expected.

Wick Harbour is a good starting point for the journey to Orkney. Aim to arrive at a point roughly halfway between Duncansby Head and the Pentland Skerries at slack water, before the beginning of the westgoing ebb tide. From there, head towards Lother rock and then enter the middle of Hoxa Sound. The tidal rates then fall quickly and there is very little tide in Scapa Flow.

When crossing the Pentland Firth heading south from Scapa Flow, leave via Cantick Head and aim to arrive halfway between the islands of Stroma and Swona at slack tide, before the start of the eastgoing flood tide. From there head southeast round Duncansby Head.

12.7 Consultation

Consultation was carried out with local recreational sailor, dive boat operators and kayakers during the NRA. The overall level of recreational vessel activity in the area is relatively low.

Recreational vessels can occasionally transit around Hoy to/from Stromness, taking about 10-12 hours. It can be done clockwise or anti-clockwise, depending on the tide. Clockwise is generally easier, but if the tides are not timed correctly then the Merry Men of Mey could be running on the ebb. It is recommended to reach Tor Ness around the ebb, crossing the Merry Men of Mey at slack water. Recreational craft tend to stay reasonably close to the shore to enjoy coastline features, typically a couple of cables (approx.350-400m). Transits are mainly carried out in summertime. Yachts during transit could also be solo sailors or groups. Other yachts could pass near the proposed area, e.g. vessels crossing the Pentland Firth, the closest which would be those crossing to/from Scrabster. Crossing from Orkney to Scrabster would normally be on the ebb tide and yachts would tend to pass west of Hoy. For the northbound crossing from Scrabster to Orkney, vessels could go west of Hoy or via Scapa Flow (in flood tide). On the latter route they would pass between Switha and South Walls and may cross the original AfL area. This is illustrated in the RYA Cruising Atlas as a ‘light-use’ cruising route. The move of the AfL area to the west has made this less of an issue.

The majority of the dive boats in Orkney (based on consultation with ODBOA, which has since been disbanded) mainly operate within Scapa Flow. There are a few wrecks in the Sound of Hoxa but this would be quite a long trip from Stromness. Most of the boats go as far as the wreck of the James Barrie trawler and no further. There is nothing much of interest to divers in the vicinity of the AfL area. It is very rare to go on a transit around Hoy for sight-seeing. Most dive boats go as far as the Old Man of Hoy for this (although it is noted a recreational angling vessel based in Stromness was observed during one of the surveys). If crossing the Pentland Firth, this would be done further west or east of the AfL area. Aith Hope is a potential shelter for dive boats but it was not considered to be too important according to the consultation feedback, as it is not used frequently.

Kayakers do not pass near Brims very often. They may occasionally take a trip circumnavigating Hoy, or part of it, such as Houton to Rackwick Bay, or anti-clockwise from Rackwick into Aith Hope (and then carry the kayaks over the causeway into Longhope) or further round the south from South Walls. Such trips are most likely to take place during summer weekends, perhaps once or twice per year (up to 3-4 per year). Ideal conditions are high pressure, no wind and neap tides. In calm conditions, kayakers can go further out from shore to benefit from the tide but they can also stay close (within 100-200m) to avoid an opposing tide. There are likely to be fewer than ten people in the group for such trips. Some kayakers cross the Pentland Firth, e.g., Brough Ness to Duncansby Head can be done in 1.5 hours. Some groups come to Brough Bay in Caithness and cross the Pentland Firth. These may pass west of Hoy or into Scapa Flow.

Other recreational stakeholder consultation is summarised in Section 13 and Appendix A.

13. CONSULTATION

13.1 Introduction

This section summarises the responses to the Project Briefing Document (PBD) relevant to shipping and navigation as well as feedback obtained from consultation carried out by Anatec with navigational stakeholders to date.

Note, the stakeholder consultation is mainly based on the original AfL area and OpenHydro technology. However, meetings on the revised site and alternative technologies were held with Orkney Fisheries Association and OIC Marine Services in July 2013. Further consultation took place with the MCA, NLB, RYA Scotland and SFF, as well as local stakeholders during the Hazard Review Workshop. The Hazard Review Workshop focused on the revised AfL area and all technology options and infrastructure presented in the proposals.

13.2 Project Briefing Document Responses

The PBD was circulated widely to national and local stakeholders in May 2012. The document included a brief overview of shipping and navigation in the area extracted from an early draft of the PHA.

The key responses to the PBD relating to shipping and navigation are summarised in Table 13.1. (Note: The name at that time was Cantick Head, which has been retained below.)

Responses to the Scoping which are relevant to shipping and navigation are presented in Table 13.3. All the following points have been taken into account within the NRA.

Table 13.1 Stakeholder Responses to Project Briefing Document

Stakeholder	Response
MCA	• The ES should supply detail on the possible impact on navigational issues for both commercial and recreational craft, including collision risk, navigational safety, risk management and emergency response, marking and lighting of site and information to mariners, effect on small craft navigational and communication equipment, the risk to drifting recreational craft in adverse weather or tidal conditions, the likely squeeze of small craft into the routes of larger commercial vessels. • A Navigational Risk Assessment will need to be submitted in accordance with MGN 371 (and 372) and the DTI/DfT/MCA Methodology for Assessing Tidal Arrays (and Wind Farms). The MGN 371 checklist format should be appended to the submission. • The NRA needs to relate to a safe Under Keel Clearance (UKC), which should allow for the worst case scenario in terms of vessel draught to safely navigate through the area. • Cumulative and in combination effects will require consideration. • Casualty information from the RNLI and MAIB should be analysed. • Reference should be made to any Marine Conservation Zones (MCZs) established or planned within the area. • The Rochdale Envelope should be used if final layout and capacity has not

Stakeholder	Response
	been concluded prior to the release of the ES. • Any reference to IALA recommendations on the marking of tidal array should refer to O-139 Edition 1 December 2008 which replaced all previous versions. • Radar and manual observations should be included in addition to AIS to ensure that smaller vessels are recorded. • Recreational activities should be considered. • Any application for operational safety zones will need to be formally submitted for review. • Consideration will need to be given to site size and location on SAR resources and Emergency Response & Co-operation Plans (ERCoP) including identified emergency towing and potential guard vessel provisions that may be required by the developer/operator. • Particular attention should be paid to cabling routes and burial depth. An anchor penetration study may be necessary.
MS-LOT	• It is noted that fishing activity is shown for vessels over 15m from VMS and MS Compliance sources. • Marine Scotland has recently undertaken a fisheries mapping project (ScotMap) which aimed to identify areas of fishing activity in the Pentland Firth and Orkney waters. This targeted mainly non-VMS (<15m vessels) and the report should be available within the next few months. This should be consulted to provide a better understanding of the AfL area. • A targeted study of smaller vessels would also be beneficial. • Cumulative impacts of Phase I will have to be assessed in the Phase II ES.
Marine Scotland Science	• Data provided on fishing vessel activity suggested to show that there are a large amount of demersal vessels in the area. These are unlikely to be fishing and most are likely to be transiting through/across the Pentland Firth. • ScotMap report should be consulted.
NLB	• Necessary marking and lighting recommendations will be made in a formal response through the Marine Licensing process. • Initially propose that turbines will not require any navigational marks as it is intended to install in 60-80m of water. • Discourage the use of an offshore substation to connect the array to shore. If considered essential it is advised to be positioned as far north as possible within the AfL area. This will require to be marked and lit for the safety of navigation. A decision on the appropriate marks and lights shall be taken once the specifications of the structure are supplied but will be based on O-139 IALA guidelines. • May also be necessary to mark the landfall site of the export cable routes, depending on the location chosen. • NRA to be in accordance with MGN 371. • In addition to AIS / radar information, further validation of statistics by gathering data regarding vessels under 15m and leisure users at a local level, will enable a more complete NRA. • Risk Assessment to include a workshop approach with local users of the area and Orkney Harbours for hazard identification and mitigation.

Stakeholder	Response
	• All navigational marking and lighting of the site and associated marine infrastructure will require Statutory Sanction of the NLB prior to deployment. • Whilst device(s) are in their operation/maintenance phase, they should be actively monitored, and a contingency plan be in place to respond to any reported catastrophic failure events which could result in any part of the device(s) breaking loose and becoming a buoyant hazard. The contingency plan should include the transmission of local Radio Navigation Warnings.
OIC	• OIC Marine Services (Harbour Authority) should be part of the regulator group. As the Statutory Harbour Authority any impacts or potential impacts on the harbour areas should be assessed early in the process. • Flotta oil terminal and Longhope RNLI would be useful additional stakeholder consultees given their proximity to the site.
OFS & OFA	• Wish stakeholders to be kept informed of any changes in the AfL search area boundaries. • Movement further west will need to take into account any blocking or limiting of access to Brims Ness.
NorthLink Ferries*	• Main concern is whether there will be an exclusion zone as the area is frequently transited in winter when there is heavy westerly swell present. • Assumed that deployment will happen during periods of favourable weather when the easterly route will not be used. • Once the turbines are in position, they should be of a depth that will not affect the ferries. • November 2010 does not represent particularly frequent use of Cantick Sound route as it was not one of the more common periods of strong westerlies, and the route will be used more frequently at times. • The AIS information provided showed very little traffic going through the area, when it is an area used fairly regularly to avoid or catch the tide depending on whether it is ebbing or flowing. • Marker buoys during development could prove dangerous to vessels navigating the Pentland Firth as there would be a high chance of them breaking loose. • When approaching Cantick Sound from the southwest, vessels sometimes pass through the AfL area. It may appear that the vessels could keep south, but due to the complex mix of tidal and swell conditions in the area they occasionally transit closer to the South Walls coastline than might be expected. This is particularly the case when avoiding strong ebb tides in order to reduce delay and improve passenger comfort. This is part of NorthLink's 'local knowledge' accrued through several years' experience on the route. • NorthLink are glad to see that there is the possibility that the AfL area may be moved further west past Brims Ness. • Require clarification whether vessels will be allowed to navigate through the area outwith the construction stage, or whether there will be an exclusion zone in place.

* Ferry operator has changed to Serco NorthLink Ferries from 5 July 2012.

13.3 PHA Consultation Meetings

Meetings were held with key national and local stakeholders during the PHA work for the original AfL area. Updated meetings on the new Brims Tidal Array site and alternative technology were held with OFA and OIC Marine Services in July 2013. Key comments from all the meetings are presented in Table 13.2.

Table 13.2 Stakeholder Comments at Meetings

Stakeholder	Meeting Comments
MCA & DfT	• Have some concerns regarding 3rd party verification of devices being developed. • Issues regarding underkeel clearance and the mariner's perception of risk, particularly at different states of tide. "Appetite for risk" may be changing as a result of projects and test devices being developed. Previously vessels tended to avoid development areas altogether, but this might not be the case in future. • Potential concerns regarding cable burial depths and protection and the on-going monitoring, based on some experience of remedial work undertaken on some of the east coast offshore wind farms. • For further consultation, official documents will go through Marine Scotland, but technical queries can be discussed directly with MCA. • Stated that in the context of Marine Guidance Note 371, the proposal would have to be considered as a major development and therefore a dedicated radar/AIS survey would likely be required. A further review will be taken on completion of the PHA. • UKHO input would be required on the markings of developments on charts.
MS-LOT	• List of stakeholders for the project, including navigational stakeholders, was reviewed. • Noted that MS's Marine Renewable Facilitators Group includes the MCA and NLB. Agreed that direct approach could be made where considered necessary provided MS were provided with feedback.
OIC Marine Services	• The AfL area currently overlaps Harbour Limits. Anything on the seabed within the Harbour Limits would need a works licence. It is expected that the actual development will be west of the Harbour Limits with the exception of the possible cable landfall at Aith Hope. • The proximity of the site will mean that Marine Services will have a strong interest and it will be important that the NRA deals with specific in-combination issues, such as the coordination of activities on the site when a tanker is approaching Scapa Flow from the west. • Tanker draught could be up to 22 metres. Tankers will follow the recommended track in calmer conditions but in adverse conditions they may take a different angle in and out. • Alternative technology ,including potential surface-piercing structures, will need full consideration in the NRA. Intelligent site layout will be needed. • Scapa VTS has good coverage of the site from their radar and AIS located on Sandy Hill. However, tracking of smaller (non-AIS) targets in the area is variable and depends on weather, sea state, size and shape of target, etc. Also radar-only vessels cannot normally be identified. Vessels under 12m

Stakeholder	Meeting Comments
	do not need to report to Scapa. • Marine Services provided an update on their facilities including the upgrades at Lyness, Hatston and Copland's Dock in Stromness. • OIC Marine Services are working on a five year Port Infrastructure Plan. The more information they can get from developers on their potential needs, the better.
Orkney Fisheries Association (OFA)	• The name change, new AfL area, potential for alternative technology and new timings for development were discussed. • Hoy fishermen (based in Longhope) and Burray fishermen use creels in the area. Names of individuals were discussed, both within and independent of OFA. • Attention was also drawn to the Orkney Sustainable Fisheries project and the ScotMap work which gives a general indication of the fishing in the area. • South of Brims area is quite exposed so not many fishermen would risk gear in the area. Some may use it at certain periods, but seasonal and weather dependent.
RYA Scotland (Orkney Coastwatcher)	• Stromness around Hoy is a popular transit, taking about 10-12 hours depending on direction of travel. It can be done clockwise or anti-clockwise, depending on the tide. Clockwise is generally easier, but if the tides are not timed correctly then the Merry Men of Mey could be running on the ebb. It is recommended to reach Tor Ness around the ebb, crossing the Merry Men of Mey at slack water. • Recreational craft tend to stay reasonably close to the shore to enjoy coastline features, typically a couple of cables (approx.350-400m). • Transits are mainly carried out in summertime. It is difficult to estimate numbers. One local skipper in Stromness identified who would do this transit. Also might be some visitors to Stromness from further afield. Yachts during transit could also be solo sailors or groups. • VHF reception is good in this area. Mobile telephone reception is unknown. • Other yachts could pass near the proposed area, e.g. vessels crossing the Pentland Firth, the closest which would be those crossing to/from Scrabster. Crossing from Orkney to Scrabster would normally be on the ebb tide and yachts would tend to pass west of Hoy. For the northbound crossing from Scrabster to Orkney, vessels could go west of Hoy or via Scapa Flow (in flood tide). On the latter route they would pass between Switha and South Walls and may cross the original AfL area. This is illustrated in the RYA Cruising Atlas as a 'light-use' cruising route. Moving the AfL area west, makes this less of an issue. • OpenHydro turbines will be on the seabed with a planned clearance of more than 30m. No risk of yacht keel interaction at these depths. The only issue would be during installation when surface vessels may pose a temporary obstruction, or if there was an offshore substation on the surface. • There are no significant recreational issues with the (original) site, provided it is depicted on charts, information is circulated via the appropriate methods, such as inclusion in the Clyde Cruising Club Sailing

<table>
<tr><th>Stakeholder</th><th>Meeting Comments</th></tr>
<tr><td></td><td>Directions, and any surface features or working vessels are adequately marked and lighted.</td></tr>
<tr><td>RNLI Stromness</td><td>
Anatec review of the RNLI call-out data for the ten-year period 2001-10 showed that most of the call-outs had been from the nearest RNLI station at Longhope. A couple were responded to by Stromness lifeboat, possibly due to the Longhope lifeboat being away at the time or undergoing repair. In one case the Stromness lifeboat was carrying out exercises in the Pentland Firth and was in the vicinity of the incident.
The two nearest Stromness incidents to the AfL area were reviewed:

On 16 March 2008, the Northern Explorer rigid inflatable boat (RIB) suffered a machinery failure and needed assistance. This was a charter vessel taking passengers on sightseeing tours. The incident occurred 2.3 nautical miles south of South Walls. (Note: The Northern Explorer subsequently sank off Stroma in 2011.)
On 3 June 2009, a person became ill on a dive vessel. This vessel had been diving at the wreck of the fishing trawler, James Barrie, which is located towards the southern end of the Sound of Hoxa.

One RNLI incident was recorded within the original AfL area. This was recorded by RNLI as a machinery failure on a power boat, although it is believed it may have been a dive vessel. A nearby incident on the south coast of South Walls involved a person on the cliff who was threatening to jump. Both of these incidents were responded to by Longhope station.
It is not thought that BTAL Project will pose any problems for the RNLI. Longhope is a relatively quiet station so if incidents increased due to the development, e.g. operational accident during installation, it will not be affecting an already busy station.
A contact person was provided for the Longhope station to allow further consultation during the NRA.
Few vessels are believed to shelter in Aith Hope, between South Wells and Hoy.
</td></tr>
<tr><td>Orkney Dive Boat Operator's Association (ODBOA)</td><td>
The majority of the dive boats in ODBOA mainly operate within Scapa Flow. Only about four venture further afield; Jean Elaine, Sharon Rose, Karin and Halten.
There are a few wrecks in the Sound of Hoxa but this would be quite a long trip from Stromness. Most of the boats go as far as the wreck of the James Barrie trawler and no further.
There is nothing much of interest to divers in the vicinity of the AfL area. It is very rare to go on a transit around Hoy for sight-seeing. Most dive boats go as far as the Old Man of Hoy for this.
If crossing the Pentland Firth, this would be done further west or east of the AfL area.
Aith Hope is a potential shelter but it is not considered to be too important.
No problems with proposed development. The turbines will be well under the water and if the surface substation option was to go ahead it should not be a concern, provided it is marked and lit.
</td></tr>
<tr><td>Kirkwall Kayak Club</td><td>
Kayakers do not pass near Brims very often. They may occasionally take a trip circumnavigating Hoy, or part of it, such as Houton to Rackwick Bay, or anti-clockwise from Rackwick into Aith Hope (and then carry the
</td></tr>
</table>

Stakeholder	Meeting Comments
	kayaks over the causeway into Longhope) or further round the south from South Walls. • Such trips are most likely to take place during summer weekends, perhaps once or twice per year (up to 3-4 per year). Ideal conditions are high pressure, no wind and neap tides. In calm conditions, kayakers can go further out from shore to benefit from the tide but they can also stay close (within 100-200m) to avoid an opposing tide. • There are likely to be fewer than ten people in the group for such trips. • Some kayakers cross the Pentland Firth, e.g., Brough Ness to Duncansby Head can be done in 1.5 hours. Some groups come to Brough Bay in Caithness and cross the Pentland Firth. These may pass west of Hoy or into Scapa Flow. There used to be an annual event with groups camping on Orkney before returning. • Overall, tidal sites are not such an issue to kayakers as wave sites since they are under the water. The key mitigation is to circulate information during installation works via Notices to Mariners, etc. • Questioned whether eddies could be created at the site by the underwater devices, similar to that an underwater rock might create. No specific modelling for this site as yet but other work has indicated wake effects would be minimal.

13.4 Scoping Responses

Shipping and navigation relevant responses to the Scoping phase from September 2013 are presented in Table 13.3.

Table 13.3 Scoping Response

Stakeholder	Response
MCA and NLB	• Under keel clearance guidance paper provided by MCA should be considered. • NRA should be submitted in accordance with MGN 371. • Assessment should take into account under keel clearance.
OIC Marine Services	• Revised AfL area is partially inside the boundaries of the Orkney Harbour Limits. • Surface piercing devices or hubs near the main entrance to an oil / gas port will need to be assessed. • Future traffic should be assessed.
RYA Scotland	• No issues if all devices were to have an adequate clearance of minimum 8m below LAT.

13.5 Additional Consultation

Table 13.4 presents details on additional consultation carried out.

Table 13.4 Additional Consultation

Consultation	Stakeholder	Response

Consultation	Stakeholder	Response
Navigation review – September 2014	NLB	• Inclusion of surface piercing or floating devices would make the application more complicated. • Southeast and southwest corners of the site to be kept clear of elements providing insufficient under keel clearance for transit. • No concern regarding an array of seabed mounted devices upscaling from 30 MW to 200 MW.
Navigation review – September 2014	MCA	• In the case of either surface piercing, floating or seabed mounted devices, the main differentiation would be whether traffic is rerouted around or through the site. • If transits through the site will be made, under keel clearance needs to be assessed in accordance with MGN 371. • Attention to be paid to southeast corner of site which overlaps the deep draught channel for Scapa Flow.
Response to revised Project Description – June 2015	MCA	• UKHO should be consulted to address how information on under keel clearance will be promulgated to the mariner. • When new devices are installed, changed or removed throughout the lifetime of the project, information on device specific details should be promulgated to Kingfisher Information Services and to local vessels using the area. • Export cable routes, cable burial protection index and cable protection needs to be addressed. MCA would accept 5% reduction in surrounding depth referenced to Chart Datum. • MGN 371 Annex 2 Paragraph 6 iii requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard. • Emergency Response Cooperation Plan (ERCoP) to be in place prior to construction.
Scottish Fisheries Meeting – June 2015	SFF and SPFA	• The majority of (larger) fishing vessels in the area shown in the VMS data and are unlikely to be fishing and most are likely to be transiting through the Pentland Firth. • The minimum under water clearance of 20 m below LAT (as proposed at the time of the meeting, now increased to 30m) should be ample for all fishing vessels in all conditions. • Fishing vessels only tend to clip the southwest corner of the AfL area (if at all) when rounding Hoy,

Consultation	Stakeholder	Response
		transiting to / from west Orkney so there should not be a significant issue even for construction or maintenance activity on site. • Although there are no plans for mandatory safety zones during normal operation, the SFF confirmed their positon that a subsea development becomes de facto excluded from fishing operations and requires mitigation. • Mitigation should be in the form of communication of activity on site to both local and visiting fishermen.
Email & Telecon – Aug 2015	Flotta Marine Oil Terminal (Talisman-Sinopec)	• Terminal receives oil from various Talisman-Sinopec North Sea fields as well as Golden Eagle (Nexen). • Expect increase in production to 2018 then decline, but this could change if new fields come on-stream. • Largest visiting tanker is in the region 16m draught. • Loaded tankers heading west past Brims would be the main concern, e.g., to Liverpool, Milford Haven or Algeciras. • Currently most exports head east, e.g., Le Havre, Rotterdam, and hence should not pass Brims. • For westbound traffic, main concern is if they needed to alter to starboard due to other traffic, which could bring them into the site. • UKC requirement is typically 50% of the static draft so looking at 24 to 30 metres depth of water. • Terminal provides navigation advice to all visiting tankers so details of the Brims Project will be circulated to Masters.

14. UNDER KEEL CLEARANCE

14.1 Introduction

This section discusses the approach taken to modelling the under keel clearance risk associated with the planned turbine array.

MCA guidance is firstly reviewed which is based on worst case assumptions. The MCA indicate this approach would be appropriate where there is no safe and reasonable deviation for marine traffic using the area and therefore passage over the turbine must be maintained in all states of the tide. In the case of Brims there is sea room available for deviation if required, therefore the probabilistic risk modelling approach used in the NRA is also described.

14.2 Review of MCA UKC Policy Paper

The purpose of the MCA Policy Paper is to provide guidance for determining safe UKC for vessels passing over sub-surface structures through calculating the worst case minimum under water clearance for the sub-surface development.

In order to calculate the worst case minimum underwater clearance the following factors have been considered by the MCA:

- Maximum tidal device elevation relative to water depth (including device safety margins);
- Tidal height variations;
- Sea state (e.g. the maximum wave height and periodicity);
- The maximum vessel draught recorded in proximity to the Project during the baseline marine traffic surveys;
- Dynamic movements of vessels e.g. pressure variations, squat, wave induced motion and the associated increase in vessel draught.

Figure 14.1 illustrates the MCA theoretical framework used to calculate the minimum UKC.

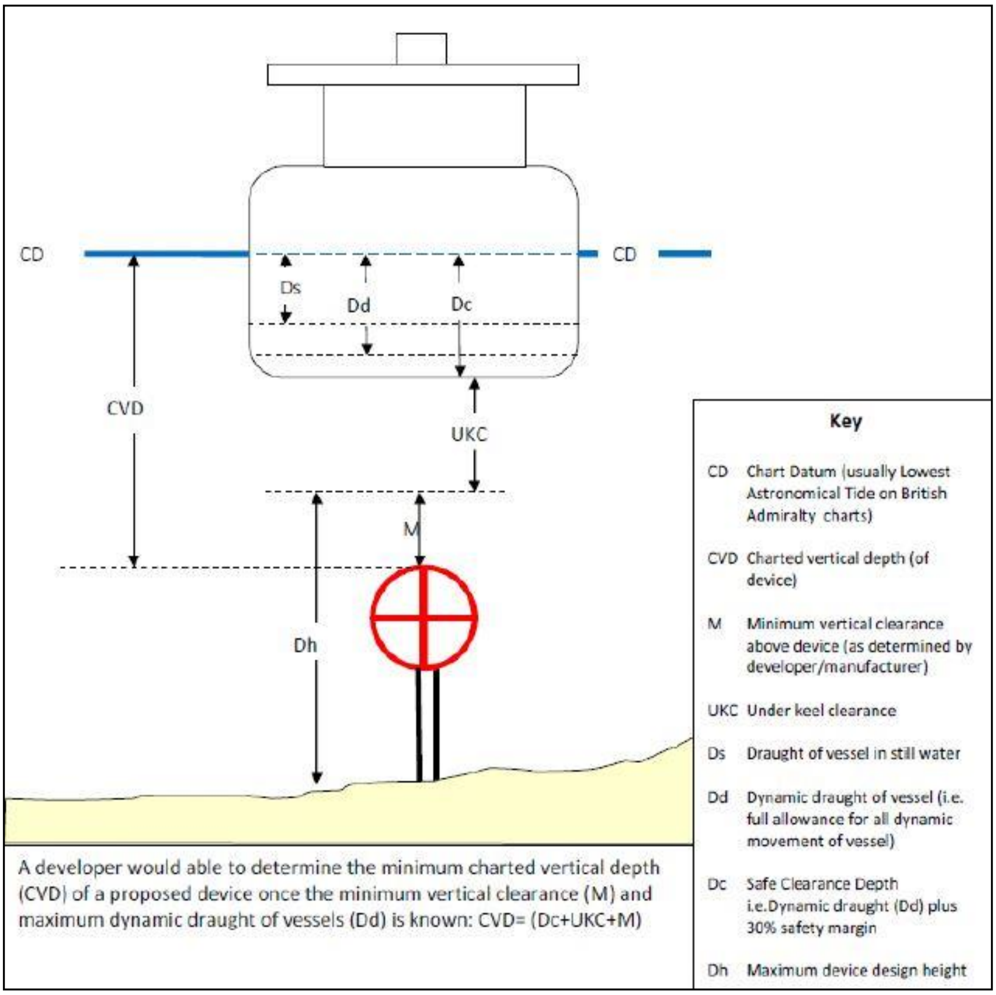


Figure 14.1 Summary of MCA UKC Theoretical Framework

The maximum tidal device height (D_h), inclusive of the tidal device specific safety margin (*M*) specified by the manufacturer, is defined as the tidal device with the smallest charted vertical depth (*CVD*) and as such, the position of each tidal device on the seabed and its height in relation to chart datum (*CD*) must be considered. The tidal device specific safety margin (*M*) is defined as the vertical distance "required above the device to ensure that vessel transits do not damage and/or are detrimental to the device (e.g. the effects of interaction between a vessel and the device)". In the case of Brims, all turbines will be designed to have a minimum *CVD* of 30m (at LAT, which is worst case) and no developer safety margin is considered necessary ($M = 0$).

In terms of vessel draught, the maximum static draughts (D_s) recorded during the 28 day maritime traffic survey were 9.1m within the AfL area and 16.6m within the wider study area. However, if more recent activity is taken into account, since ship-to-ship transfers restarted in Scapa Flow in March 2015, the deepest draughts were 20.8m in the AfL area and 21.5m in the study area. It is considered appropriate to use this up-to-date data.

The dynamic draught (D_d) is calculated from the cumulative effect of sea state, pressure variations, squat and other wave induced motions to account for the full allowance of dynamic vessel movement. The highest significant wave height in the data set reviewed was 15m, with an amplitude from sea level to trough of 7.5m. Assuming an additional 1m to account for effects such as worst-case squat and surge, the D_d values would be 29.3m (AfL area) and 30m (study area). The MCA Policy Paper also states a safety margin equal to 30% of the total dynamic draught must be added to obtain a safe clearance depth (D_c). Adding this safety margin, the safe clearance depth (D_c) value is 38.1m (AfL area) and 39.0m (study area).

Using these values, it can be seen that the minimum (worst-case) design depth of 30m does not meet the safe clearance depth. However, this is based on a range of worst case assumptions and does not take into account the fact that larger vessels can safely deviate to avoid the turbine array if they consider there is a risk of allision, e.g., in extreme sea states and low tide.

Therefore, the NRA has investigated the extent of the issue using a probabilistic risk assessment approach outlined in the next section, which was used by Anatec for similar studies at Meygen Inner Sound and EMEC Fall of Warness.

14.3 NRA Methodology

The NRA methodology used to calculate the UKC allision risk has been based on extensive research into UKC using literature, papers and consultation with vessel masters and operators. The method has been developed based on Anatec's past experience of tidal energy developments.

An illustration of the factors taken into account by the model is presented in Figure 14.2 (which shows a generic turbine, not necessarily the one to be used at Brims).

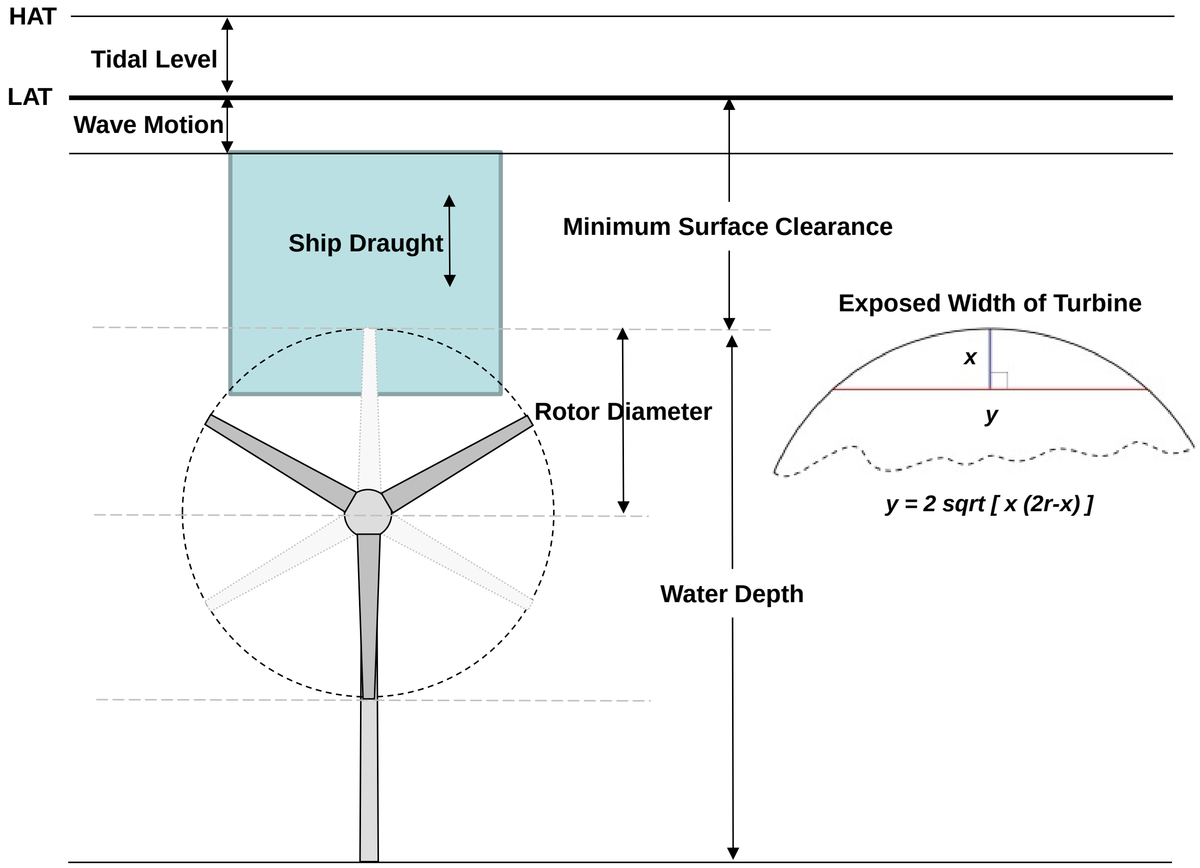


Figure 14.2 Illustration of Factors affecting Turbine / Vessel Keel Interaction in NRA

The following factors that affect under keel clearance have been considered within the UKC allision risk modelling:

- Minimum surface clearance for each device;
- Vessel draught distribution;
- Tidal height variations;
- Wave-induced vessel motion;
- Vessel squat; and
- Surge

The minimum clearance was assumed as 30m for all devices. This is conservative as the clearance is likely to be even greater than this at many locations across the site, where there is more water depth.

The draught distribution came from the survey data, with more recent data used for tankers visiting Scapa Flow, to reflect the fact that ship-to-ship transfers have restarted.

Tidal height was based on the long-term tidal prediction presented in Section 6.

The area is subject to wave action and ships will experience heave, roll and pitch motions which combine to produce vertical displacements of the hull. The magnitude of the vertical displacement is dependent upon several factors including the height and period of the waves, the vessel type, dimensions and speed, the relative vessel heading to the waves and the water depth. From research, accurately predicting ship response is complicated. Therefore, results from field measurements and recommendations from literature have been reviewed and conservatively adapted for the vertical wave-induced motions component.

The Permanent International Association of Navigation Congresses (PIANC, 1997) recommends a value of 0.3 to 0.5 times the ships' draft for minimum depth clearance requirements in channels influenced by waves, where the higher value is for wave above 1m and wave periods and directions are unfavourable.

Typically Vessel Masters are recommended to maintain a minimum under keel clearance of 10% to 50% of their static draught when passage planning, though this is dependent on local factors.

The US Army Corp of Engineers (US ACE, 1995) recommends a wave motion value equal to 1.2 times the incident wave height be used in channel design. This is in-line with the extreme measurements from results from a large field measurement program in a high-wave-energy entrance channel at the mouth of the Columbia River, USA (Wang, 1980).

To be conservative in accounting for wave motion at the Brims Tidal Array, 1.2 times the range of significant wave heights presented in Section 6 has been assumed, i.e., 2.4 times the wave amplitude.

Squat was neglected based on consultation feedback which indicated it should be low in this area, given the relatively open waters and existing water depth, and any effects should be encompassed within the conservative wave motion factor.

Similarly, changes in water depth due to surge, which can lead to small increases (positive surge in low pressure) or decreases (negative surge in high pressure) in sea level versus tidal predictions, were neglected. It will more commonly raise rather than lower the sea level, and any negative effects should be encompassed within the conservative wave motion factor.

14.4 UKC Conclusion

The MCA guidance indicates a small proportion of the deepest-draught vessels could exceed the design clearance of the turbines at Brims Tidal Array based on worst case assumptions relating to dynamic motions. However, larger vessels are free to deviate to avoid the risk of subsea interaction (if required in extreme conditions). The NRA therefore uses a probabilistic approach, as has been done for other UK tidal energy projects. The results of the risk assessment are provided in Section 16.

15. FORMAL SAFETY ASSESSMENT

15.1 Introduction

The impact assessment is based on the IMO Formal Safety Assessment process (IMO, 2002) approved by the IMO in 2002 under SC/ Circ.1023/MEPC/Circ392, and referred to in Section 2.4.

As indicated within the IMO FSA guidelines and the DECC guidance on risk assessment methodology (DECC, 2013) for offshore renewable projects, the depth of the assessment should be commensurate with the nature and significance of the problem. Within the assessment of proportionality consideration was given to both the scale of the development and the magnitude of the risks/navigational impact.

From review it was concluded that the Project is a large-scale development with the potential to impact navigational safety. As a result, the content and methods of the risk assessment were responsive to this and included the following:

- Comprehensive Hazard Log
- Risk Ranking
- Detailed and quantified Navigational Risk Assessment for selected hazards
- Preliminary search and rescue overview
- Preliminary emergency response overview
- Comprehensive risk control/mitigation measures log.

15.2 Hazard Identification

A Hazard Review workshop was held at Orkney Marine Services Harbour Authority Building, Scapa on 3 June 2015, with attendees listed in Table 15.1 and invitees who were unable to attend listed in Table 15.2.

Table 15.1 Hazard Review Workshop Attendees

Attendee	Title	Organisation
John Beattie	Principal Risk Analyst	Anatec
Sandy Bendall	Lead Risk Analyst	
Michael Lewis	Project Manager	OpenHydro
Alistair Wylie	Deputy Harbour Master Operations	Orkney Marine Services
David Sawkins	Deputy Harbour Master Strategy and Support	
Willie Mackay	Vessel Master	Serco Northlink
Fiona Mathieson	Representative	Orkney Fisheries Association
Andrew Livingston	Fisheries Officer (Kirkwall)	Marine Scotland
Mike Grainger	Representative	Royal Yachting Association (Scotland)
Ian Johnstone	Renewable Energy Consultant	Aquatera
Steven Driver	Navigation Officer	Northern Lighthouse Board

Table 15.2 Hazard Review Workshop Invitees unable to Attend

Invitee	Title	Organisation
Kevin Kirkpatrick	Coxswain	Royal National Lifeboat Institute (Longhope)
--	Duty Manager	Flotta Oil Terminal
Robert Smith	Skipper	Orkney Creel Fishermen's Association
Kenny Budge	Skipper	Fishing vessel "*Caspian*"
Magnus Norquoy	Skipper	Fishing vessel "*Samantha Jane*"
Gary Kirkpatrick	Skipper	Fishing vessel "*Guiding Light*"
Graham Russell	Planning and Environment Officer	Royal Yachting Association
Nick Salter	Offshore Renewables Advisor	Maritime and Coastguard Agency
Michael Cooper	Local Representative	Cruising Association
David Bowdler	Director	Orkney Marinas

The purpose of the workshop was to identify and review the potential navigational hazards associated with the planned development of the Brims Tidal Array.

The Hazard Review Workshop focused on the revised AfL area and all technology options and infrastructure presented in the proposals at that time, which included the potential for surface-piercing substations. The minimum under water clearance at that time was 20m (which since increased to 30m).

A full record of all hazards assessed at the Workshop is presented in Appendix A. Hazards relating to surface-piercing technology have subsequently been removed from the NRA (Operational Hazards 1, 2 and 11), although the numbering remains consistent with Appendix A for clarity.

The following hazards are relevant to the NRA based on the final project design:

Operation:

- Passing vessel powered allision with submerged device.
- Passing vessel drifting allision with submerged device.
- Displacement of vessels due to avoidance of site leading to increased passing vessel-to-vessel collision.
- Fishing gear interaction with subsea equipment within site (e.g. device, foundation or inter-array cable).
- Vessel anchoring on or dragging anchor over subsea equipment within site.
- Fishing gear interaction with export cable to landfall.
- Vessel anchoring on or dragging anchor over export cable to landfall.
- Loss of tidal device or part of device (e.g. component failure).
- Restricted search and rescue capability in an emergency situation (or increased demand due to Project).

- Restricted oil spill response in a pollution incident (or increased demand due to Project).

Construction:

- Displacement of vessels due to avoidance of site / construction vessels (and associated safety zone) leading to increased passing vessel-to-vessel collision.
- Collision between passing vessel and construction vessel either at site or en route.
- Dropped object during construction activities at site.
- Man overboard during operations within the site.

It was emphasised at the outset that the discussion needed to take into account differences between types of vessels, e.g., fishing, recreational and merchant.

The discussion was recorded at the meeting and a brief summary of key points made about each hazard is presented below, with full discussion is presented in Appendix A.

Hazard 3: Passing Vessel Powered Allision with Submerged Device

- The Master of the *Hamnavoe* stated they would not leave harbour in any conditions where wave heights may result in interaction with devices at 20m below LAT.
- Very deep draught vessels are the only ones likely to be at risk. It would be very unlikely that a large tanker would deviate into the AfL area (taking into account mitigation of not developing the southeast corner of the AfL area or ensuring additional clearance in this sector).
- The use of aids to navigation to mark the site was discussed. It was concluded that buoyage would not be desirable as the devices are well below the water, and not a hazard to the vast majority of vessels. The proposed buoys would present a surface allision risk of their own and it would be challenging to ensure they remained on station in areas of strong tidal flows, such as Brims.

Hazard 4: Passing Vessel Drifting Allision with Submerged Device

- The average Flotta Oil Terminal tanker is 10-12m, although a very large crude carrier (VLCC) called in Scapa Flow in March 2015 with a draught of around 22m. This would only be likely to enter the area if it had suffered a breakdown, in which case the submerged turbines would be least of its worries, as it would be in danger of grounding on the coastline. The most likely outcome in the event of interaction would be breakage of a turbine rotor blade.
- The prevailing tidal flows would tend to take vessels in the main Outer Sound shipping lane parallel to the shore rather than towards Brims.
- The use of nearby harbour tugs (located in Scapa Flow) was suggested as a mitigation measure to reduce the risk of a drifting vessel allision risk. These vessels are not equipped to deal with very large merchant vessels and concerns were raised over potential difficulties to attach a tow line in adverse conditions.
- Braking of OpenHydro turbines in a drifting scenario would not provide any additional underwater clearance. Braking of open rotor devices was noted as potential mitigation, to be considered further in the Emergency Response Cooperation Plan.

This would not be assumed in the modelling as it cannot be guaranteed to provide any additional clearance.

Hazard 5: Displacement of Vessels due to Avoidance of Site leading to Increased Vessel-to-Vessel Collision Risk

- The potential for displacement due to avoidance of the site, leading to increased vessel-to-vessel collision risk, would be minor due to the low level of traffic in and around the development area.
- The vast majority of vessels, such as those routeing west of Hoy, would not need to alter their passage plan as under keel clearance is adequate.

Hazard 6: Fishing Gear Interaction with Subsea Equipment within Site

- Fishermen do not want to lose any gear due to the high costs associated with replacing it. In this area, fishing gear is set and visited every few days, noting that the ability to visit fishing gear is highly dependent on prevailing weather and tidal conditions. Gear is hauled once or twice per fortnight coinciding with periods of suitable weather and tide.
- Fishing representatives felt that the development was effectively creating an exclusion zone for most fishermen due to the risk of losing gear, which was noted as a commercial issue (to be covered under commercial fisheries chapter). The final decision to fish or not within the development area rested with the skipper, however, fishing activity could not be ruled out following construction. The area is currently a high risk area in terms of gear loss (due to strong tidal streams) however a limited number of fishermen, who have developed specific skills and knowledge for working in the area, are willing to take the risk as it is financially rewarding.
- The addition of subsea hazards would be most likely to end fishing within the AfL. Even for those who currently risk fishing within the AfL fishing would most likely cease because of the increased operating dangers and increased gear loss risks. It does not preclude the fact that commercial pressures may lead some to attempt to fish within the site.
- Engagement with local fishermen is essential. It was noted that all fishermen who use the area had been invited to the Workshop, but it was understandable that they could not attend due to work commitments.

Hazard 7: Vessel Anchoring on or Dragging Anchor over Subsea Equipment within Site

- It was agreed that vessels are not likely to anchor in the vicinity of the AfL area due to water depths, with the weight of chain which would be required to anchor in these depths presenting a safety risk.
- Also unlikely that vessels would carry enough chain to anchor in these depths, therefore this hazard should be dismissed as minimal risk.

Hazard 8: Fishing Gear Interaction with Export Cable

- The majority of the seabed in the area is scoured rock, therefore the export cable will require protection with concrete mattressing / rock dumping.
- Fisheries representatives preferred burial in order to minimise the risk of interaction with fishing gear, however if burial is not possible, local fishermen should be consulted to ensure that protection methods were a sympathetic to fishing as possible.

Hazard 9: Vessel Anchoring on or Dragging Anchor over Export Cable

- Noted that the likelihood of a large vessel anchoring in the vicinity of the AfL area is low.
- One landfall option, Aith Hope, is used as a mooring for local fishing vessels and occasionally as anchorage for recreational vessels. It was therefore noted that if the Aith Hope export cable route was selected the cable would require sufficient protection from fishing and recreational vessel anchoring.

Hazard 10: Loss of Device or Component

- The phased development approach would allow for a deploy and monitor strategy for a subset of devices to confirm their adequacy for the Brims site, in support of full scale development.
- There is significant operational experience of the OpenHydro device from existing sites. Also the OpenHydro will be DNV-certified.
- Noted that the device does contain buoyant components, but there are limited scenarios which would result in these buoyant components breaking free. Part of the function of the Emergency Response Cooperation Plan would be to detail the communication protocol to relevant parties, including the Coastguard and Orkney VTS, if a buoyant component were to break free.
- The likely consequence of an external object, such as debris, alliding with a device was queried. It was stated that the most likely consequence would be failure of the blades.
- A rolling maintenance programme will help identify any potential issues early on, thus limiting the likelihood of device / component failure.

Hazard 12: Restricted Search and Rescue Capability in an Emergency Situation (or Increased Demand due to Project)

- Concluded that no significant impact on search and rescue capability is expected. It was noted that the development could increase the burden on existing search and rescue resources. There will be the requirement for a level of self-help. The development also has the potential to enhance the SAR capability with regard to responding to third party incidents as per SOLAS.

Hazard 13: Restricted Oil Spill Response in a Pollution Incident (or Increased Demand due to Project)

- There is not expected to be any effect on the water surface from the submerged turbines so would be no significant impact on the oil spill response capability.
- There will only be very limited oil inventories used on-site.

Hazard 14: Displacement of Vessels due to Avoidance of Site / Construction Vessels leading to Increased Passing Vessel-to-Vessel Collision Risk

- It was confirmed that current methods of information promulgation (Notice to Mariners, issued by both Orkney VTS and UKHO) would be adequate for NorthLink Ferries and therefore no need to specifically target information.

- Noted that a marine manager (or coordinator), particularly with respect to the coordination of construction traffic routeing, would be useful. A marine manager has been deployed at other OpenHydro sites.
- Safety zones were discussed, and it was noted that it is standard industry practice to have rolling safety zones which would apply only when necessary, i.e., work vessels on site and restricted in manoeuvrability.
- A blanket exclusion zone covering the whole site is likely to be unacceptable. The application for safety zones is normally made post-consent and pre-construction.

Hazard 15: Collision between Passing Vessel & Construction Vessel (at Site or en Route)

- Should not be a major issue due to vessels complying with COLREGS in open seas during transit.
- Vessel selection and auditing would help minimise the risk.
- The marine manager would help as a focal point for communication between vessels.
- Orkney VTS operates an advisory service within their jurisdiction; they do not instruct traffic but they can help control movements to avoid encounters, e.g., if there was a scenario with a VLCC outbound and a Brims workboat inbound. Current AIS and radar coverage of the Project was stated as being very good, with all vessel movements recorded. CCTV is in operation but limited by prevailing weather conditions.

Hazard 16: Dropped Object

- Fishing representatives had a preference for 'dry storage' (i.e. taking to land) versus 'wet storage' if any object had to be recovered, although it was noted wet storage can reduce overall mileage.

Hazard 17: Man Overboard

- Concern was noted regarding the increasing burden on search and rescue resources. Emphasis was placed on the need for self-help as the primary means of response. This would include using personnel trained in offshore survival, suitable PPE and fast rescue craft.

15.3 Hazard Ranking Methodology

The ranking of the risks associated with the various hazards was subsequently carried out by Anatec using professional judgement and experience based on the discussion at the Hazard Review Workshop, together with the baseline data analysis and other consultation. The draft rankings were then circulated to the workshop attendees, and other interested parties who were unable to attend, for further feedback and agreement. A risk matrix was used based on the frequency and consequence categories shown below.

Table 15.3 Frequency Bands

Rank	Description	Definition
1	Negligible	< 1 occurrence per 10,000 years
2	Extremely Unlikely	1 per 100 to 10,000 years
3	Remote	1 per 10 to 100 years

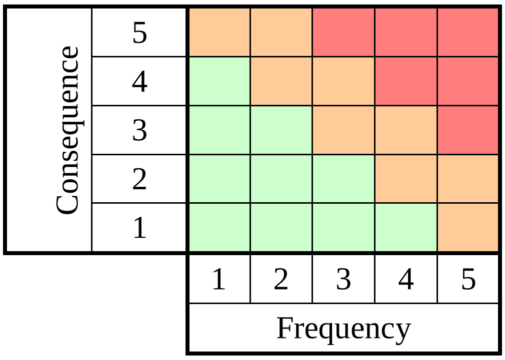
4	Reasonably Probable	1 per 1 to 10 years
5	Frequent	Yearly

Table 15.4 Consequence Bands

Rank	Description	Definition			
		People	Environment	Property	Business
1	Negligible	No injury	<£10k	<£10k	<10k
2	Minor	Slight injury(s)	Tier 1: Local assistance required	£10k-£100k	£10k-£100k
3	Moderate	Multiple moderate or single serious injury	Tier 2: Limited external assistance required	£100k-£1M	£100k-£1M Local publicity
4	Serious	serious injury or single fatality	Tier 2: Regional assistance required	£1M-£10M	£1M-£10M National publicity
5	Major	More than 1 fatality	Tier 3: National assistance required	>£10M	>£10M International publicity

The four consequence scores were averaged and multiplied by the frequency to obtain an overall ranking (or score) which determined the hazards position within the risk matrix shown below.

Table 15.5 Risk Matrix



where:

	Broadly Acceptable Region (Low Risk)	Generally regarded as insignificant and adequately controlled. None the less the law still requires further risk reductions if it is reasonably practicable. However, at these levels the opportunity for further risk reduction is much more limited.
	Tolerable Region (Intermediate Risk)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate control measures are in place, residual risks are as low as is reasonably practicable (ALARP) and that risks are periodically reviewed to see if further controls are appropriate.
	Unacceptable Region (High Risk)	Generally regarded as unacceptable whatever the level of benefit associated with the activity.

The hazard was ranked by expected risk (based on the estimated frequency versus consequence) with no (or basic) mitigation measures applied, and residual risk following application of industry standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop. An example of the methodology and the full set of results are presented in Appendix A.

15.4 Risk Rankings

The final hazard log contained 25 navigational hazards (due to several hazards being subdivided by vessel type). This was reduced to 18 following the removal of hazards relating to technologies no longer considered within the final PDS.

Figure 15.1 presents the breakdown of the hazards by tolerability region.

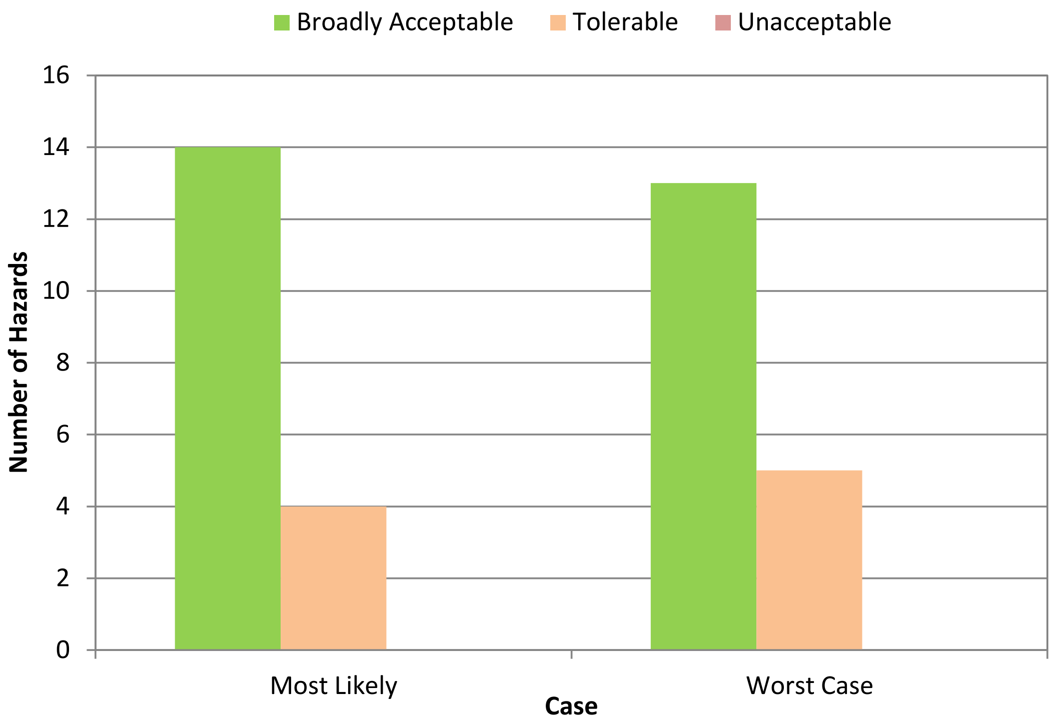


Figure 15.1 Brims Tidal Array Risk Ranking Results

No hazards were assessed as being unacceptable. The majority of hazards were assessed as being broadly acceptable both in the most likely scenario and in the worst case scenario. However there is still a requirement that risks are properly assessed and appropriate control measures are put in place to ensure residual risks are ALARP. The potential mitigation measures identified for each hazard are listed in Appendix A.

Further details on all hazards identified (including causes, frequency and consequence rankings and potential risk control/mitigation measures) are recorded in the Hazard Log (see Appendix A).

15.5 Risk Assessment

Following identification of the key navigational hazards, risk analyses were carried out to investigate selected hazards in more detail. This allowed more attention to be focused upon the high risk areas to identify and evaluate the factors which influence the level of risk with a view to their effective management.

The following scenarios were investigated in detail, quantitatively or qualitatively.

Base Case Without Project:

- Vessel-to-vessel collisions

Base Case With Project:

- Vessel-to-vessel collisions
- Vessel-to-turbine allisions (powered and drifting)

Future Case Without and With Project (as above)

(Base case assumes current traffic levels and future case uses future traffic levels based on predicted change over the life of the Project.)

All the quantified risk assessments were carried out using Anatec's COLLRISK software which conforms to the DECC methodology as outlined in Annex D3 in the Guidance (DECC, 2013). In line with this, Anatec makes the declaration that the models used within this work have been validated and are appropriate for the intended use. As required the following have been considered and justified:

- Tuning of parameters
- Consistency checks
- Behavioural reasonableness
- Sensitivity analysis
- Comparison with the real world

The results of the detailed risk analyses are presented in Section 16.

15.6 Risk Control Options

The different risk control measures/options were identified within the hazard ranking process. Full details of the measures are presented within the Hazard Log (Appendix A). A summary of measures adopted by the project is presented in Section 20.

16. RISK MODELLING AND ASSESSMENT

16.1 Introduction

This section assesses the allision and collision hazards associated with the development of the Project.

16.2 Change in Vessel-to-Vessel Collision Risk

From the review of the baseline traffic, as well as the workshop outcomes, it was assessed that the Project will have a minimal impact on vessel routeing during normal operations due to the minimum design under water clearance of 30m or more below LAT. Therefore, any change in vessel-to-vessel collision is likewise assessed to be minimal, compared to the base case without the Project.

However, there could be temporary impacts on vessel routeing during construction and decommissioning when large vessels, at times restricted in manoeuvrability, are on-site, with associated safety zones of up to 500 metres. This is discussed in Section 17.

16.3 Vessel Allision with Structure Risk

The assessment considered the risk of allision with the subsea devices. As discussed in Section 14, the probability of vessels alliding with the subsea devices depends mainly on the following factors:

- Under water clearance below LAT;
- Vessel draughts;
- Tidal height variations; and
- Wave-induced vessel motion.

The minimum device clearance is planned to be 30m below the water level at LAT (approximately chart datum). LAT is the lowest water level that can be expected to occur under average meteorological conditions and under any combination of astronomical conditions. They are not extreme levels, as certain meteorological conditions can cause a higher or lower level (e.g. surge).

Draughts of vessels transiting the sea area within the Study Area were obtained from survey data, including up-to-date tanker data on large tankers visiting Scapa Flow between Match and July 2015 (see Figure 10.4).

The full range of tidal and wave heights, summarised in Section 6, were used in the probabilistic modelling.

There are two main scenarios for passing vessels alliding with offshore structures such as subsea tidal devices. The potential for additional vessel to structure allision risk has been modelled using vessel routes based on the survey data from the maritime traffic survey.

- Transiting (under-power) vessel allision; and
- Drifting vessel allision.

Each scenario is assessed below.

Transiting Vessel Powered Allision

This assessment considered the risk of a vessel alliding with a subsea device during a transit under power due to human error.

Model runs were performed based on the indicative layout assuming no avoidance of the site by vessels, i.e., vessels keep using the routes identified from the surveys. This is a conservative assumption as, in reality, mitigation measures will be taken to make mariners aware of the Project through chart depiction, Notices to Mariners, port liaison, etc. Therefore, deep-draughted vessels will have the opportunity to alter their passage if they felt there was a credible allision risk, e.g., in heavy sea states and low tide. It is possible they will do this as a precaution to avoid passing over the devices.

The modelling also assumes vessel movements will occur in all sea states, including significant wave heights of up to 15m, which again is conservative.

The annual powered allision frequency with the Phase 1 devices was estimated to be 1.8×10^{-5} per year, corresponding to an average of one allision in 54,600 years.

For Phase 1 & 2 devices the annual powered allision frequency was estimated to be 2.8×10^{-4} per year, corresponding to an average of one allision in 3,500 years.

It can be seen that the allision risk is an order of magnitude higher for the full-build out compared to Phase 1 only. This is partly because of the increased number of turbines but mainly due to the fact that Phase 2 includes turbines in the southern and eastern extremities of the site, closer to the baseline routes used by deep-draughted vessels.

The geographical distribution of the risk across the full site is presented in Figure 16.1. It can be seen that the highest risk area is the SE corner due to tankers visiting Scapa Flow.

It is emphasised that this has been thematically mapped on a relative basis and the total frequency of interaction is low, even with the conservative assumptions used in the modelling, including no avoidance by deep-draughted vessels of turbines in the SE corner.

Further discussions are planned with navigation stakeholders regarding whether further mitigation is required of the SE corner, such as excluding part of the area from development or having additional under water clearance.

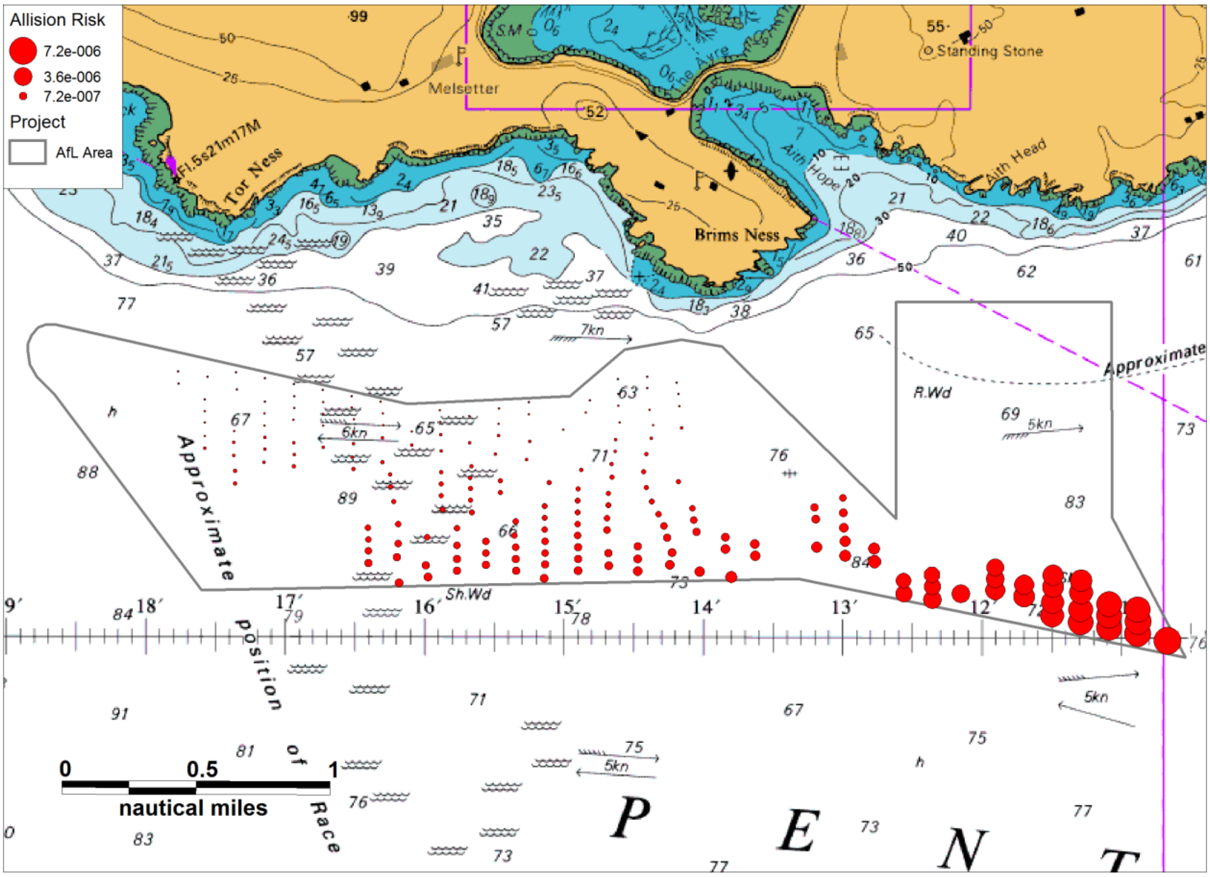


Figure 16.1 Geographical Distribution of Powered Allision Risk – Phases 1 & 2

Drifting Vessel Allision

This assessment considered the risk of a vessel alliding with a subsea device due to equipment failure on the vessel.

The risk of a vessel losing power and drifting into a device was assessed using Anatec's COLLRISK model. This model is based on the premise that propulsion on a vessel must fail before a vessel will drift. The model takes account of the type, size and draught of the vessel, number of engines and average time to repair in different conditions.

The exposure times for a drifting scenario are based on the vessel-hours spent in proximity to the AfL area. These have been estimated based on the traffic levels and speeds. The exposure is divided by vessel type, size and draught to ensure these factors are taken into account within the modelling.

Using this information the overall rate of breakdown within the area surrounding the Project was estimated. The probability of a vessel drifting towards a device location and the drift speed were modelled using peak flood and ebb tide conditions as well as weather-dominated drift. As expected, the worst case results were for the tidal drift scenarios due to their faster rate of drift.

The probability of vessel recovery from drift is estimated based on the speed of drift and hence the time available before reaching the device. Vessels that do not recover within this time are assumed to allide if they pass over the subsea turbines and their dynamic draught (including wave and tidal effects) exceed the underwater clearance.

The annual drifting allision frequency with the Phase 1 devices was estimated to be 7.2×10^{-8} per year, corresponding to an average of one allision in 14 million years.

For Phase 1 & 2 devices the annual drifting allision frequency was estimated to be 2.3×10^{-7} per year, corresponding to an average of one allision in 4 million years.

Again, the full build-out array has a much higher frequency but the overall numbers are very small which reflects a combination of facts including:

- Large vessel blackouts are relatively uncommon events
- Tides would generally drift vessels east-west rather than into the site
- Only a limited number of vessels could potentially interact with the devices
- Interactions could only occur in extreme conditions, even for deep-draughted vessels

It is noted that a large drifting vessel in this area would be at risk of grounding on shore in any case, even without the turbines present, the consequences of which are likely to be much more severe.

16.4 Future Case Marine Traffic

All the allision risk is contributed by deep-draught vessels using the southern approaches to Scapa Flow (either visiting Flotta Terminal or for STS transfer) or transiting the Outer Sound of the Pentland Firth. The Scapa Flow tanker traffic is the main risk contributor.

The analysis of the Scapa Flow traffic was brought up-to-date using March-July 2015 data (four months) as it was recognised that the 2013-14 maritime traffic surveys occurred during a period when tankers did not call at Scapa Flow. The 2015 period included visits by tankers greater than 20m in draught for STS transfer, as well as regular traffic to Flotta Terminal. This provides a certain amount of future-proofing, although if the number and/or size of visiting tankers varies in the coming years, the risk numbers will also vary.

In the case of the Outer Sound, this is used by traffic routeing to/from a diverse range of ports / countries in northern Europe. In terms of deep draught vessels that could conceivably interact with the Brims turbines, these were mainly large bulk carriers and crude oil tankers. This traffic will vary due to fluctuations in trading between ports as well as economic factors, such as world growth. The drop in oil price since the 2013-14 surveys were carried out may lead to a reduction in transiting tanker traffic within the Pentland Firth but this is likely to fluctuate over the life of the Project

From discussion with Flotta Terminal, they expect an increase in exports up to about 2018 which is then expected to decline, although new fields coming on stream could alter this. Another factor would be if more exports headed west (e.g., Mediterranean) resulting in the tanker passing Brims, rather than east as most currently do.

Overall, it is expected the gradual decommissioning of the North Sea will lead to a net decrease in crude oil movements in the vicinity of Brims over the life of the Project. However, as the risk results are sensitive to changes in the movements of a small subset of deep-draughted vessels (12m draught and above), which could fluctuate during the life of the Project, a 50% increase has been conservatively assumed for the future case.

Finally, it is recognised that the number of transits by other traffic, such as cruise ships, ferries, fishing and recreational vessels may also fluctuate but these vessels are not relevant to the risk modelling due to the ample under keel clearance they will have if / when transiting the Brims site.

16.5 Risk Results Summary

The base case and future case annual levels of risk without and with Project site are summarised in the tables below and in Figure 16.2.

Table 16.1 Summary of Results – Phase 1

Allision & Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	1.8E-05	1.8E-05	--	2.7E-05	2.7E-05
Passing Drifting	--	7.2E-08	7.2E-08	--	1.1E-07	1.1E-07
Vessel-to-Vessel	Negligible change			Negligible change		
Total	--	1.8E-05	1.8E-05	2.83E-03	2.8E-05	2.8E-05

Table 16.2 Summary of Results – Phases 1 & 2

Allision & Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	2.8E-04	2.8E-04	--	4.3E-04	4.3E-04
Passing Drifting	--	2.3E-07	2.3E-07	--	3.4E-07	3.4E-07
Vessel-to-Vessel	Negligible change			Negligible change		
Total	--	2.8E-04	2.8E-04	2.83E-03	4.3E-04	4.3E-04

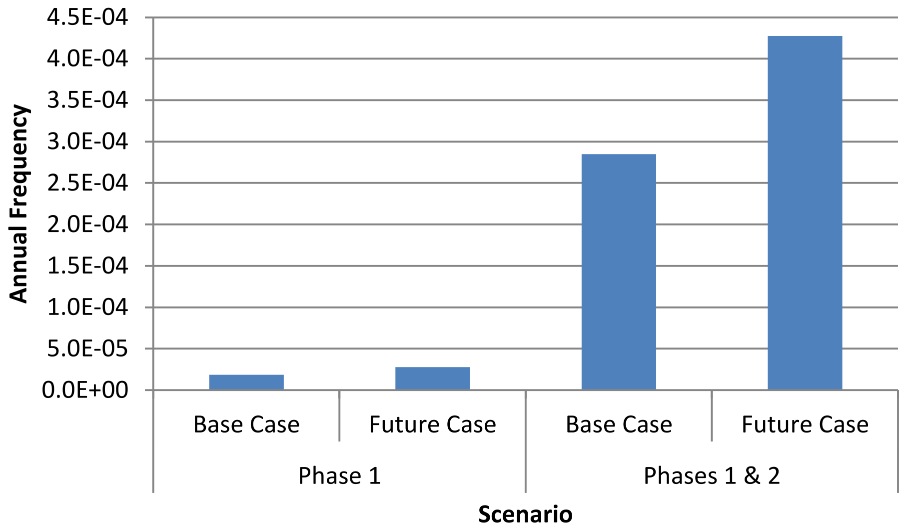


Figure 16.2 Summary of Results

For Phase 1, the allision frequency is estimated to increase due to the Project by approximately 1 in 54,400 years (base case) and 1 in 36,300 years (future case).

For Phases 1 & 2 (combined), the allision frequency is estimated to increase due to the Project by approximately 1 in 3,500 years (base case) and 1 in 2,300 years (future case).

The relatively low frequencies reflect the minimum 30m under water clearance of the devices which means they will be out of reach for most vessels operating in the area in most sea conditions.

16.6 Consequences

Within the hazard ranking process (see Section 15), the consequences of allision were ranked based on various criteria.

Taking into account the removal of surface-piercing structures from the design, and the increased minimum clearance to 30m, it is only very large vessels that could potentially interact with the subsea devices.

In this case, the expected outcome is minor, e.g., rotor blade damage with only superficial damage to the underside of the vessel. Therefore, no fatalities or oil spills are expected as a result of an allision with the turbines.

17. CONSTRUCTION AND DECOMMISSIONING IMPACTS

17.1 Introduction

The quantitative risk assessment primarily focused on the operational phase of the tidal array, however, it is recognised that there will be additional (potential) temporary impacts during the construction and decommissioning phases of the Project.

During these activities, in addition to the allision risk to passing vessels from the subsea turbines, there will be working vessels in the area which could be restricted in manoeuvrability. This could pose a surface collision risk and an obstruction to navigation for all vessels, irrespective of their draught.

An initial review is presented below, recognising that full details on the technology, work vessel types / sizes and base ports are not yet known. A navigation safety plan will be prepared prior to the commencement of the development, which will take into account the finalised construction plans and vessels involved.

17.2 Description of Activity

Details on the expected activity at the site during installation and maintenance are presented in Section 4.

A summary of the estimated vessel requirements is given in Table 4.2. (The decommissioning process is the reverse of the installation procedure and requires the same plant and machinery.)

Table 17.1 Project Vessel Requirements

Activity	Vessel	Time Present in AfL Area
Installation of turbine support structures Installation of turbines	Selection of: • DP construction vessel with 250 to 400 tonne crane lift capacity plus DP construction vessel with 150 tonne crane lift capacity; • Purpose built twin hulled three point heavy lift barge; and / or • Jack-up barge / moored barge depending on site conditions and selected turbine support structure. Support vessels: small DP vessels with ROV on board, crew transfer vessels (RIBS), dive vessels (RIBS), tug boats.	Phase 1: 2019 – 2020 Phase 2: 2021 - 2023
Installation of cables	Specialised cable installation vessel.	Phase 1: Early 2019 Phase 2: 2020/2021

Activity	Vessel	Time Present in AfL Area
Installation of cable protection & stability measures	Specialised vessels comprising one of: • Vessel with fall pipe (rock placement); and / or • Heavy lift crane vessel for concrete mattresses and grout bags; • Inspection class ROVs.	Phase 1: 2019 Phase 2: 2020/2021
Landfall activities	Jack-up barge for sea to shore HDD.	Phase 1: 2019 Phase 2: 2020/2021
Routine inspections	Offshore small (25 – 30m) work class DP tug or similar with ROV on board. RIBS and dive boats may also be required.	Ongoing
Preventative maintenance	Small (25 – 30 m) work class tug or similar vessel, work class ROV and RIB.	Ongoing
General maintenance	Large DP crane vessels or purpose built twin hulled three point heavy lift deployment barge for installation of OCT with turbine support structure as single unit. Other support vessels including small DP vessel, crew transfer vessel and dive boats.	Every five years for each turbine – ongoing for Project life

It is expected the majority of marine construction activities will take place during summer and autumn months when the weather conditions are favourable. Installation will take place around slack water periods on a neap tide in sea state 4 or less. This should help mitigate the risk to any other passing vessels in the area which will be experiencing the same conditions.

17.3 Safety Zones

During construction / installation it is standard industry practice to have safety zones of up to 500m radius on a ‘rolling’ basis, covering only those areas of the site in which construction activities are taking place at the current time.

The application is made to the Department of Energy and Climate Change (DECC) under section 95 and schedule 16 of the Energy Act 2004, and also the Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007. Normally this application is made post-consent and pre-construction, when final details on the project are known.

The purpose of the safety zones is to manage the interaction between passing (3rd party) vessels and the offshore construction vessels with a view to minimising the risk of an incident which may threaten life, the environment and / or assets. The fundamental principle is that vessels would be kept at a safe distance from construction activities related to the Project in order to avoid collisions, interaction and interference with the works.

The safety zone prohibitions do not apply to certain vessels, including those entering or remaining in a safety zone owing to stress of weather, when in distress or acting in connection with the saving or attempted saving of life or property.

Safety zones anywhere in the site could affect the sea room available to traffic using the area, such as that seen in the maritime traffic surveys including the *Hamnavoe* ferry, large tankers routeing via Scapa Flow, general merchant traffic rounding Hoy and local fishing vessels. However, the effect would be limited by the 'rolling' nature of the safety zone, with only one location expected to be active at a time.

Examples of standard 500m radii safety zones centred on indicative turbine positions closest inshore, further NW and SE, are presented in Figure 17.1 (note, all of these locations are Phase 2).

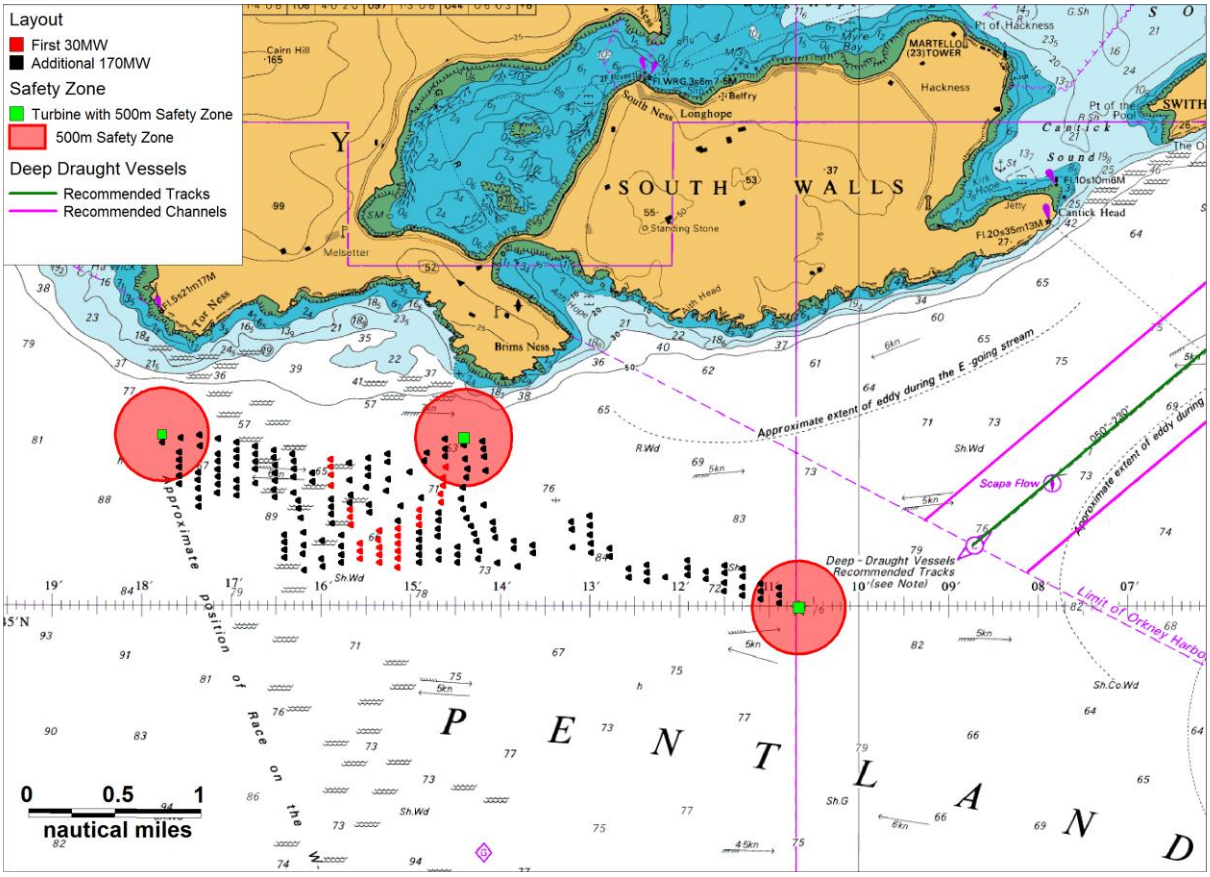


Figure 17.1 Potential Area occupied by 500m Radii Safety Zones (centred on Turbine Locations)

It can be seen that a 500m safety zone at the indicative turbine location closest to shore would reduce the sea room available inshore of the site to around 100-200m, potentially pushing passing vessels further offshore. Construction activity at the SE end of the site could temporarily restrict the sea room available to vessels entering or exiting Scapa Flow, including large tankers using the recommended track. Similarly, construction towards the west end of the site could affect traffic rounding Hoy, such as the vessels heading to/from the Faroes.

In all cases the adjustments required by passing vessels would be relatively minor and temporary. However, whilst the maximum safety zone dimensions that can be granted under the regulations are 500m, there is flexibility to apply for smaller zones, which could be appropriate where sea room is limited, whilst protecting workers taking part in the activity. The DECC guidance on applying for safety zones around offshore renewable energy installations (DECC, 2011b) states the following:

> *Whilst standard dimensions of 500 metres (the maximum permissible under international law) during construction, major maintenance, possible extension and decommissioning will normally apply, all applications will be assessed on a case by case basis taking into account site specific conditions.*

Therefore, it is recommended the developer seeks to establish only the minimum safety zones required to ensure the safety of working vessels, in consultation with the MCA, DECC, the appointed contractor and local stakeholders, taking into account the sea room available surrounding the finalised layout.

The safety zones would apply only temporarily during activity on site when working vessels are restricted in manoeuvrability. This should be indicated on the vessels by displaying appropriate marks/lights, and by updating their navigational status on AIS.

17.4 Other Mitigation Measures

To minimise any impacts it is recommended that operating procedures are in place to ensure working vessels do not restrict passing traffic and local fishing and leisure vessels when not actively engaged in working on the site. If it is not practicable for the working vessel to depart from the site in between operations then it should use appropriate marks and lights, and status updates on AIS, to indicate to other vessels that it is not restricted in manoeuvrability (if the case) and hence any safety zone would not be operational at that time.

During work activity, it will be vital that information is circulated to local users to ensure they are kept informed of the activity on a day-to-day basis. This can be achieved by setting up a contact list for distributing this information. Liaison with Orkney VTS and local fishing and recreational organisations would be part of this.

For vessels planning to transit in the vicinity from further afield, various measures can be used such as:

- Notices to Mariners
- Maritime Safety Information broadcasts

- Kingfisher fisherman's awareness charts
- Updated Sailing Directions and depiction on UKHO Admiralty Charts

A guard vessel will be nominated during construction to monitor passing traffic and police safety zones. This could be a vessel involved in the work or a separate vessel specifically for this task. More generally, all working vessels should have collision risk management procedures advising what action to take in the event of a vessel approaching on a collision course. Working vessels should be able to move out of the way of a collision threat if they detect it in time, although they may be restricted in their manoeuvrability at certain stages of the operation. The procedures should include use of visual lookout, radar and AIS equipment for detection and VHF DSC for communication. Also working vessels should be equipped with AIS and update their navigation status as appropriate during the operation.

Once firmer details are available of the vessels / contractors that will be carrying out the work and the base ports, it is recommended that a navigation safety plan is prepared to identify potential hazards associated with the activities as well as appropriate mitigation measures and operating procedures relevant to the selected vessels, the passages being used to and from port, the local marine environment and construction methods. This would include risk from tidal races and large swells. Appropriate allowable weather and tidal criteria will be needed. It is recommended local knowledge is consulted when developing these plans.

Experience and lessons learned from other marine renewables projects should also be reviewed prior to the work being commenced.

The same process should apply for major maintenance and decommissioning of the Project.

18. CUMULATIVE AND IN-COMBINATION EFFECTS

The main potential cumulative and in-combination effects are considered to be from other wave and tidal projects in the Pentland Firth and Orkney waters (PFOW) area, shown in Figure 18.1.

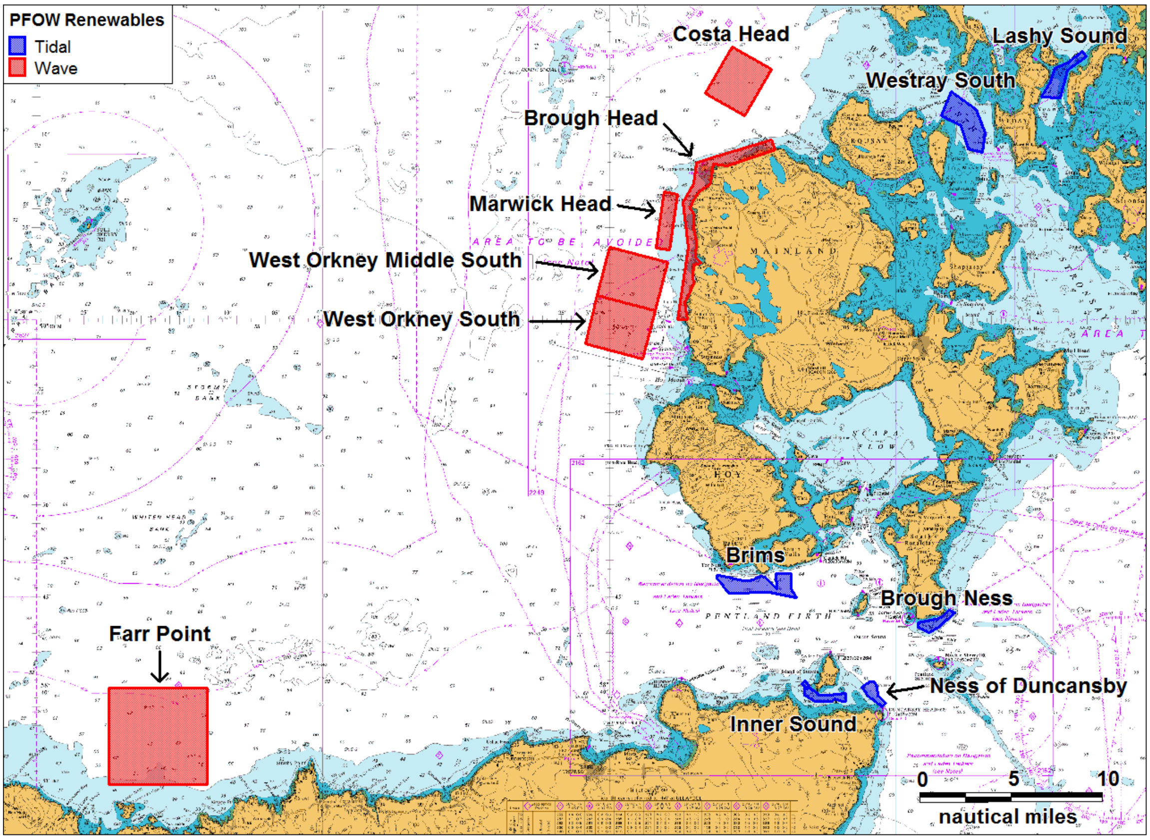


Figure 18.1 Wave and Tidal Projects within Pentland Firth and Orkney Waters

All the other projects are over five nautical miles from the Brims AfL area. Based on a review of available information on the projects, including The Crown Estate Strategic Area Navigation Appraisal (SANAP) (Crown Estate 2014), it is considered there will be no potential for cumulative impacts on vessel routeing, as it was assessed that Brims will have minimal impact on traffic flows within the Pentland Firth.

The only potential cumulative impact could arise from construction and maintenance activity if work vessels for Brims are based at ports also being used by other developments, e.g., Lyness and/or Scrabster. This could lead to congestion in and around the ports, especially if the main construction periods were to overlap However, this is not considered to be a significant impact and can be managed (if necessary) through liaison between developers and the Port Authorities.

19. LOSS OF STATION AND OTHER NAVIGATION ISSUES

19.1 Introduction

This section considers the hazards associated with loss of station of a device or part of a device.

A number of additional navigational issues identified within MGN 371 (MCA, 2008a) which are not covered elsewhere within this report are also discussed within this section.

19.2 Loss of Station

Loss of a device or a part of a device was raised as a concern during consultation due to the strong tidal flows through the area. This was discussed at the Hazard Review Workshop.

BTAL is obviously aware of the strong tidal energies which they are planning to harness. The design will be subjected to 3rd party verification for use off Brims, taking into account extreme conditions such as waves and tides. The phased installation will help limit the consequences of any initial problems.

In the event of a part becoming detached, its fate will depend on whether it is buoyant. If negatively buoyant the part could end up on the seabed outside the site area and pose a hazard to fishing vessels. Buoyant parts, if detached, could end up floating on the sea surface.

On-site monitoring will be carried out continuously via a SCADA system, which will alarm if abnormal measurements are received indicating a potential problem. This will be received and acted upon by appropriate personnel. There will be an emergency contact available 24 hours per day.

If the SCADA system indicated loss of station, the emergency response would include informing HM Coastguard, RNLI, local harbours and users, so that vessels in the area can be alerted to the potential hazard. The emergency response procedures will be documented within an Emergency Response Cooperation Plan (ERCoP) for the project, as per MGN 371, which will be agreed with the MCA prior to the installation work commencing. This will include a plan for recovery of any lost components.

19.3 Visual Navigation and Collision Avoidance

This is not relevant for the project as the turbines will be under the water in all states of the tide. During Installation work the visual impact of working vessels should be minor and similar to other surface vessels.

19.4 Potential Effects on Waves and Tidal Currents

Unlike a fixed obstruction to the flow, the turbine is moving, and essentially mixing the water, therefore, wake effects are smaller than would result from blockage to the flow, such as from a rock.

Modelling of other projects has been carried out to investigate whether turbines could cause localised turbulence, e.g., eddies, which has been raised as an issue by navigational stakeholders. This indicated there would be some disturbance to the flow at depth, but this was not significant for surface navigation in the water column above or in the vicinity of the turbines. Project-specific modelling of hydrodynamic effects is planned to investigate this issue for Brims Tidal Array but the relatively deep submerging of the devices at 30m below LAT or lower, means that no significant effects are anticipated.

19.5 Sedimentation/Scouring Impacting Navigable Water Depths in Area

There exists the potential for structures in the tidal stream to produce siltation, deposition of sediment or scouring which could affect the navigable water depths in the turbine area or adjacent to the area. Based on the ES, there are expected to be no significant effects at Brims.

19.6 Structures and Generators affecting Sonar Systems in Area

No evidence is known of with regard to under water tidal devices to suggest that they produce any kind of sonar interference which is detrimental to the fishing industry, or to military systems. No impact is anticipated for the Project.

19.7 Electromagnetic Interference on Navigation Equipment

Based on the findings of the trials at the North Hoyle Offshore Wind Farm (MCA & QinetiQ, 2004), the wind farm generators and their cabling, inter-turbine and onshore, did not cause any compass deviation during the trials. However, it is stated that, as with any ferrous metal structure, caution should be exercised when using magnetic compasses close to turbines.

In the case of the Brims underwater turbines, it is noted that all equipment and cables will be rated and in compliance with design codes. Given the water depth at the site, any generated fields in this area are expected to be very weak.

As the turbines are subsea they should have no impact on marine radar or other marine electronics devices such as VHF, GPS, AIS or LORAN.

19.8 Noise Impact

The concern requiring to be addressed under MGN 371 is if acoustic noise from the development could mask prescribed sound signals. During normal operations, the turbines will be under water, therefore, ships' whistles and foghorns will be audible over the background noise. There is no reason to believe that the sound level of the development will have any significant influence on marine safety.

During installation there could be additional activities such as piling, but this will be subsurface and temporary.

20. RISK MITIGATION MEASURES

This section summarises the risk mitigation measures which have been embedded into the project design or are planned for the Project.

Firstly, several mitigation measures have been incorporated into the design of the Project as the development has progressed to reduce the impact on various receptors. The relevant measures for shipping and navigation, which have been adopted by BTAL, are listed below.

- The AfL area has been revised, with 80% of the area for investigation shifted to the west, and the remaining 20% overlapping with the original site. Initial consultation identified this as a positive step to mitigate the risk of vessels using the western approaches to Scapa Flow, including tankers and the Scrabster-Stromness ferry.

- Floating devices were initially under consideration in the original design envelope, but were removed, which again was seen as positive mitigation by navigation stakeholders as it reduced the risk of allision as well as potential for loss of station.

- The phased development approach will allow for a deploy and monitor strategy, i.e., the smaller number of devices in Phase 1 will be monitored for adequacy before the full scale development.

- In June 2015, surface piercing hubs were removed from the project design envelope, meaning that the entire project will be seabed mounted and will not contain any surface piercing element. This significantly reduces the potential for vessel allision, which had previously been identified as the main hazard at the stakeholder workshop, prior to this decision being taken.

- Finally, in August 2015, it was confirmed that the planned minimum clearance of turbines below the water level at LAT (approximately chart datum) would increase from 20 m to 30 m.

Other mitigation measures planned for the project have been divided into standard industry practice measures listed in Table 20.1, which are generally carried out for any UK offshore renewables project, and additional, Project-specific (enhanced) mitigation measures which have been identified during the course of the NRA, listed in Table 20.2. These additional measures have mainly been identified during consultation and from suggestions made at the Hazard Review Workshop (see Appendix A).

Table 20.1 Standard Industry Practice

Standard Industry Practice
Adverse Weather: There will be adverse weather working policies and procedures for periods of construction and maintenance.
AIS on vessels: AIS to be fitted on all workboats working at the Project
Alerting system: Control system will produce an alert in the event of a failure of a device or a component part.

Standard Industry Practice
Cable Inspection: Periodic surveys of the cable will be carried out to ensure protection measures remain effective.
Chart Depiction: The Project will be depicted on Admiralty Charts produced by the UKHO.
COLREGS: Working vessels will comply with the International Collision Regulations.
Emergency Response Cooperation Plan: An ERCoP will be prepared for the Project following the template provided by the MCA in MGN 371. This will be submitted to the MCA for approval prior to construction.
Equipment and Training for Site Personnel: Site personnel will be suitably equipped and trained for work offshore, meeting RenewablesUK Health and Safety Executive (HSE) guidelines.
Fishing Awareness: Details of the Project will be included in fishermen's awareness charts, e.g., Kingfisher.
Guard Vessel during Construction: When there are work vessel(s) on site, one vessel will be nominated as a guard vessel with appropriate procedures for traffic monitoring and collision risk management.
Inspection and Maintenance: There will be appropriate inspection and maintenance procedures in place for all elements of the Project.
Lessons Learned: Experience and lessons learned from incidents, accidents and near-misses at other marine renewables projects will be taken into account.
Maritime Safety Information (MSI) Broadcasts: HM Coastguard will be informed of work at the site to allow it to issue MSI broadcasts as appropriate.
Marking and Lighting: The Project will be marked and lit (if required) according to NLB and MCA requirements.
Notice to Mariners: Notices to Mariners will be issued prior to the start of construction and where necessary during work at the site.
Onshore Control Room: There will be an onshore control room to monitor the Project.
Personal Protective Equipment: Appropriate PPE will be worn by all working at the Project.
Safety Management System (SMS): A SMS will be in place throughout the Project.
Safety Zones: Mandatory safety zones (of up to 500m) will be applied for during the construction work.
SCADA: Supervisory control and data acquisition system to be carried out continuously and will alarm if abnormal measurements are received indicating a potential problem.
VHF: During work at the site there will be continuous watch by VHF including DSC.

Table 20.2 Project Specific (Enhanced) Mitigation Measures

Project Specific (Enhanced) Mitigation Measures
AIS Aid to Navigation (AtoN): Potential use of AIS as an AtoN to mark site boundary and / or subsea turbines to be discussed and agreed with NLB.

Project Specific (Enhanced) Mitigation Measures
Drills: Coordination with local harbour to carry out combined drills / exercises.
Fast rescue craft: Fast rescue craft onboard construction vessel.
Marine Coordinator: Appointment of marine manger to coordinate construction traffic / work vessel movements.
Navigational warnings: Orkney VTS will liaise with Coastguard and navigational warnings will be broadcast.
Orkney VTS: Liaison with Orkney VTS about project activity and vessel movements either within the harbour area or in the vicinity.
Promulgation of information to fishermen: Circulation of information to local fishing organisations to ensure information is passed to local fishermen.
Promulgation of information to recreational users: Additional circulation of information to surrounding recreational marinas that may be called on before or during visits to Orkney.
Sailing directions and almanacs: Details of the Project will be circulated to relevant organisations for inclusion in updated Sailing Directions (e.g. Clyde Cruising Club) and Almanacs.
South-eastern corner development limits: Avoid developing SE corner of site where large tankers to/from Scapa Flow may transit. Alternatively, have additional under water clearance in this area to ensure safe passage.
Tugs: Three tugs are located in Scapa Flow with the potential to tow a drifting vessel.
Vessel selection: Enhanced vessel selection and auditing.
Wet Storage: Wet storage to be minimised.

Consultation on mitigation measures will continue with Marine Scotland, the MCA, NLB and other relevant stakeholders post-application to agree the final details.

21. CONCLUSIONS AND RECOMMENDATIONS

A Navigation Risk Assessment for the Brims Tidal Array has been carried out following the MCA and DECC Guidance for such assessments.

This included baseline data collection to obtain information on the vessel activities in the vicinity of the Project, combining seasonal AIS and radar survey data, long-term fisheries data, desk-based information and consultation with local stakeholders / experts.

During the winter survey there were 20 transits through the Brims AfL area, of which six were fishing vessels, five cargo vessels, four passenger vessels, one military, three classed as "other" and one unidentified. In the summer period, there were 21 transits through the AfL area, of which 11 were cargo ships, eight were fishing vessels and two were recreational vessels. In addition, both surveys logged a small number of visual sightings of small vessels within and near the site, mainly by local fishing vessels.

The potential hazards to this vessel activity posed by the Project have been assessed based on consultation, a Hazard Review Workshop involving a cross-section of local stakeholders, and quantitative risk modelling. Based on the mitigation embedded in the project design, and by applying standard industry practice and additional, project-specific mitigation identified during consultation and at the Hazard Review Workshop, all of the risks were assessed to be either broadly acceptable or tolerable (ALARP) with mitigation. Examples of mitigation include ensuring local fishermen are kept informed of development at the site and that appropriate cable protection is used.

The quantitative modelling results indicated the allision and collision risks are very low, which reflects the fact that the minimum under water clearance of 30m put the devices out of reach of the vast majority of vessels operating in the area in all but extreme conditions. Also the consequences of any interaction are likely to be minor for the large vessels that would be invoved. The majority of the risk is associated with turbines in the SE corner of the site (Phase 2).

Details of the planned control measures are listed in this report. Further consultation will be carried out with key stakeholders such as Marine Scotland, the MCA and NLB, to ensure these are implemented appropriately and to agree any further measures required.

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Hazard Review Workshop Report
Brims Tidal Array
(Appendix A)

Prepared by:	Anatec Limited
Presented to:	Brims Tidal Array Limited
Date:	20 August 2015
Revision No.:	01
Ref.:	A2455-BTAL-NRA-1 App A

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1. Introduction

This appendix summarises the main points from the Brims Tidal Array Hazard Review Workshop held at Orkney Marine Services Harbour Authority Building, Scapa.

The purpose of the workshop was to provide an opportunity to consult with both statutory and local stakeholders in order to identify potential hazards to shipping and navigational safety associated with the Brims Tidal Array project.

The results of the Hazard Review Workshop form an important part of the Navigation Risk Assessment (NRA) for the proposed developments.

The Hazard Review Workshop focused on the revised AfL area and all technology options and infrastructure presented in the proposals. This Appendix presents full record of all discussion of all hazards referred to at the Workshop. This includes discussions of hazards which relate to surface-piercing hubs that have since omitted from the final version of the Project Design Statement. It should also be noted that the proposed minimum clearance from turbine blade tip to sea surface at LAT was 20m at the time of the Workshop (now extended to 30m).

2. Attendees

Table 2.1 summarises attendees at the Brims Tidal Array hazard workshop and the organisation they represent. Following this, Table 2.2 summarises other invitees to the workshop who were unable to attend on the day.

Table 2.1 Hazard Workshop Attendees

Attendee	Minute Initials	Title	Organisation
John Beattie	JB	Principal Risk Analyst	Anatec
Sandy Bendall	SB	Lead Risk Analyst	
Michael Lewis	ML	Project Manager	OpenHydro
Alistair Wylie	AW	Deputy Harbour Master Operations	Orkney Marine Services
David Sawkins	DS	Deputy Harbour Master Strategy and Support	
Willie Mackay	WM	Vessel Master	Serco Northlink
Fiona Mathieson	FM	Representative	Orkney Fisheries Association
Andrew Livingston	AL	Fisheries Officer (Kirkwall)	Marine Scotland
Mike Grainger	MG	Representative	Royal Yachting Association (Scotland)
Ian Johnstone	IJ	Renewable Energy Consultant	Aquatera
Steven Driver	SD	Navigation Officer	Northern Lighthouse Board

Table 2.2 Hazard Workshop Invitees who were unable to Attend

Invitee	Title	Organisation
Kevin Kirkpatrick	Coxswain	Royal National Lifeboat Institute (Longhope)
TBC	Duty Manager	Flotta Oil Terminal
Robert Smith	Skipper	Orkney Creel Fishermen's Association
Kenny Budge	Skipper	Fishing vessel "*Caspian*"
Magnus Norquoy	Skipper	Fishing vessel "*Samantha Jane*"
Gary Kirkpatrick	Skipper	Fishing vessel "*Guiding Light*"
Graham Russell	Planning and Environment Officer	Royal Yachting Association
Nick Salter	Offshore Renewables Advisor	Maritime and Coastguard Agency
Michael Cooper	Local Representative	Cruising Association
David Bowdler	Director	Orkney Marinas

3. Minutes

The key notes from the shipping and navigation hazard workshop for the Brims Tidal Array are summarised in the following sub-sections.

3.1 Project Description

ML provided an overview of the proposed Brims Tidal Array project and associated marine infrastructure. During this overview the following comments were made:

- ML stated that there was the potential for up to two offshore substation (surface piercing) platforms to be located within the AfL area, likely to be as close to shore as possible but at present they were unable to confirm exact positions. However, the stated preference of the development is that substations be located subsea. JB noted that as surface piercing platforms cannot be ruled out, these will be considered as "worst-case" within the NRA.
- MG queried how high the offshore substations would protrude from the water surface (if surface piercing were selected) as he had concerns about the overall visibility of surface piercing elements. ML confirmed that the offshore substations would be very tall and highly visible platforms, like the existing test device in EMEC Fall of Warness.
- ML stated that construction of the first 30 Mega Watts (MW) is scheduled to start in 2019, subject to the necessary consents being obtained.
- DS queried how tidal devices will be mounted to the seabed. ML stated that if the OpenHydro tidal device is selected devices will be mounted to the seabed using Gravity Base Structures (GBS). A specially designed catamaran barge will be used for the installation of these structures placing the GBS and mounted OpenHydro device in one movement. Other potential technologies included as part of the application will be mounted to the seabed using either GBS or piles.

- FM queried the maximum footprint of the GBS. ML stated the largest GBS would be 30 x 40m.
- AW queried if the diameter of current commercial OpenHydro device was 16m. ML confirmed this but said that at Brims up to 20m diameter is being considered for the OpenHydro device, and potentially larger (up to 23m diameter) for other technology.
- MG and DS asked the minimum under water clearance afforded by the development. ML stated that a minimum of 20m under water clearance to Lowest Astronomical Tide (LAT) would be available. However, the actual under water clearance is likely to be much greater than this in reality at most locations if the OpenHydro tidal device is selected, e.g., could be 30-40m clearance in 70m of water.
- MG asked if floating (and thus surface piercing) tidal turbine devices were included as part of the application. ML stated that only subsea tidal turbine devices were included. MG stated that this is easier for recreational craft transits.
- ML provided an overview of the proposed device layout. DS raised concerns about the turbines positioned in the south eastern extent of the AfL and the potential for interaction with traffic (particularly deep draught tankers) transiting to / from Scapa Flow. DS highlighted that this was a very important route for shipping. ML stated that the layout illustrated is indicative only and that there is scope throughout the final layout design process for this south eastern area of the AfL to be avoided. JB noted the deeper water in that area meant any devices could have > 20m clearance.
- WM queried if the construction phase was intended to be seasonal. ML stated that construction would not be limited by season per se but was likely to be constrained by significant wave height (up to 2m approx.) and slack tide.Hazard Review

3.2 Baseline Data Presentation

SB provided an overview of the navigational baseline including maritime traffic surveys undertaken to date and analysis of specific maritime users. During the presentation the following comments were made:

- DS and AW confirmed that all tankers have a pilot onboard for the entry / exit to Scapa Flow, with the prevailing weather and overall size of the vessel determining at which point the pilots board and disembark. For Very Large Crude Carriers (VLCCs) pilots tend to board at the previous port, which in the past has included Aberdeen and Forth, or off Duncansby Head.
- DS stated that large tankers visiting Flotta do not use the eastern approach, with an estimated 99.9% of tankers entering / exiting Scapa Flow using the western approach (west of Swona). This is due to the greater available sea room allowing more space for turning thus minimising the overall risk to the tanker. This is also partly due to the loss of steerage these large tankers experience when transiting at less than six knots. Tug boats are employed to help control these tankers at low speeds.
- FM stated that the marine traffic survey data (2 x 14 day survey periods) provided only a snapshot of data and was not truly representative of yearly fishing activity, with peak seasonal fishing activity not recorded. For example the mackerel fishery, which is typically of short duration but high intensity, was not likely to be picked up by the survey data. JB noted that longer-term VMS and sightings data were also being

used to define the baseline, but these can also under-represent small vessel activity. More recent data in the form of Succorfish and ScotMap were also being checked.

- FM stated that the Succorfish data comprised a representative selection of fishing vessels within the Pentland Firth and Orkney Waters, and therefore was not inclusive of all fishing vessel activity. Plans are in place to install the Succorfish device on more fishing vessels as the initiative continues. JB noted that the *Samantha Jane* (a fishing vessel recorded in the marine traffic surveys operating in the AfL area) does not carry the Succorfish device and the skipper indicated that the vessel can fish much farther from shore, between Brims and Caithness, which is not indicated by the current set of Succorfish data. A separate commercial fisheries study is being progressed for the Project. FM recommended meeting with the fishermen.
- DS noted that tanker movements using the western entrance to Scapa Flow had only recently restarted and would not have been present during the surveys. The largest draught tanker using the western approach had a draught of over 22m (March 2015). JB stated that this had been picked up in the analysis and a later slide showed other AIS data from 2011-12 which included tankers to/from Scapa Flow.DS said he would provide names and draughts of recent tanker calls.
- MG stated that he had recently carried out research on the draught of sail training vessels, stating that the largest he had identified (worldwide) was 7.8m and therefore unlikely to be impacted by the presence of the tidal devices. WM indicated it was unusual for the draught of these vessels to be greater than 5m. SB also noted that it was common for these larger sail training vessels to transit established shipping lanes, such as the Outer Sound of the Pentland Firth.
- Ferry tracks on AIS were reviewed. WM stated that during adverse weather the *Hamnavoe* would usually take the weather route via Scapa Flow when heading northbound to Stromness. WM stated that frequent course alterations (between 10 – 20 degrees) were common due to the nature of the sea area (tide and swell) for passenger and cargo comfort and safety. During an ebb tide in westerly swell the *Hamnavoe* tends to pass in closer proximity to the shore (closer to Brims Ness and hence the AfL area). WM also stated that the incidence of adverse weather routeing was highly variable and the route taken was dependent on the prevailing weather conditions, passing traffic as well as Master's preference. Anatec presented longer-term AIS data from the Preliminary Hazard Analysis (Scoping phase) which illustrated the diverse tracks taken by the *Hamnavoe*.
- FM raised concerns about the development of the project increasing the burden on existing Search and Rescue (SAR) resources, particularly increasing the number of RNLI call outs, which could in turn impact on the RNLI volunteers, many of whom are fishermen. JB summarised the requirement for the Project to have emergency response plans and "self-help" to mitigate the impact on existing SAR resources.
- MG queried if this level of self-help would extend to guard vessel provision. JB stated that it was standard practice for a nominated guard vessel to be present during the construction phase when vessels were already working in the area, but not for the operational phase when the vessel being out at sea 24/7 would be a hazard in itself.

3.3 Hazard Identification and Discussion

Discussions were held on hazards which had been identified prior to the workshop (from experience) and that were brought up during the workshop. Potential causes and mitigation measures suggested for each hazard were then discussed. Discussions for each hazard are summarised in Section 3.4 (throughout operational phase) and Section 3.5 (throughout construction phase). These hazards, causes and mitigation measures were recorded to generate the Hazard Log which forms part of the NRA (see separate spreadsheet).

Following discussion of these pre-identified hazards, attendees were given the opportunity to raise any other hazards which had not been discussed. These additional hazards and discussions are summarised in Section 3.6.

3.4 Operation

3.4.1 Passing vessel powered allision with surface platform

- MG stated that approximately 600 visiting recreational vessels transit within Orkney waters each year and there could be potential difficulties in promulgating information to these users, particularly when a number of these visitors transit directly from Scandinavia. However it was agreed that vessels transiting directly from Scandinavia would be unlikely to transit through the AfL area.
- In order to ensure effective promulgation of information to recreational users, it was proposed that information would be provided to nearby marinas that may be called on before visiting Orkney (e.g. Wick and Scrabster).
- SD stated that NLB have concerns regarding the south eastern corner of the AfL due to routeing of large vessels to / from Scapa Flow. ML stated that the layout illustrated is indicative only and that there is scope throughout the final layout design process for this south eastern area of the AfL to be avoided.
- SD stated that marking (including the use of radar reflectors) and lighting of the surface substations would the most effective means of primary mitigation. SD stated that 5nm range lighting would most likely be used, with the effectiveness of this lighting monitored. MG queried where the lighting would be positioned on the structures. SD stated that current Northern Lighthouse Board requirement is for all lighting to be positioned at least 2m above any other obstruction.
- SD stated that the use of AIS as an aid to navigation would be considered but noted that it is not applicable for all mariners. The issue of potential proliferation of AIS AtoNs was also discussed.
- FM stated that the use of Kingfisher notifications was an effective means of promulgating information about the development to larger fishing vessels. Local fishing organisations such as OFA will also cascade information to all members and other relevant parties thus ensuring that local vessels are aware of the development.
- The use of subsea substations, rather than surface-piercing, was identified as a means of reducing the overall allision risk. If subsea substations were not possible it was indicated that excluding substations from high risk areas (south eastern and south western extents of AfL) would reduce the overall allision risk.

- WM indicated a preference for substations to be positioned as close to the shore as possible if surface-piercing. He highlighted the considerable swell and highly variable conditions often experienced in the area, which can result in having to make course alterations every few ship lengths.
- FM re-iterated that the conditions often experienced within the Pentland Firth can be treacherous and small vessels transits are often dictated by the dominant tide / weather conditions.
- There was a consensus that operational safety zones were unlikely to be justified.

3.4.2 Passing vessel drifting allision with surface platform

- It was noted that a drifting vessel in the area would be a hazardous situation in any case (without the Project) due to the grounding risk.
- The prevailing tidal flows would tend to take vessels in the main Outer Sound shipping lane parallel to the shore rather than towards Brims. WM stated that tidal whirlpools are known to occur in the local area, the influence of which most likely would take a vessel clear of the AfL area but in very close proximity to land.
- The use of nearby harbour tugs (located in Scapa Flow) was suggested as a mitigation measure to reduce the risk of a drifting vessel allision risk. These vessels are not equipped to deal with very large merchant vessels and concerns were raised over potential difficulties to attach a tow line in adverse conditions.
- WM highlighted that the incidence of vessels only having one means of propulsion was declining, with the highest potential consequence vessels (large cargo, tanker and passenger vessels) frequently having more than one more engine, although it was highlighted that not all components may have redundancy.
- The MCA emergency towing vessel "*Herakles*" is located approximately four hours steaming time from the Brims AfL area. However the contract for this vessel expires in March 2016 and therefore it may not be present during the construction and operational phase of the Brims Tidal Array.
- The potential for other renewable energy developers in the area to share SAR resources was discussed as a potential mitigation measure.

3.4.3 Passing vessel powered allision with submerged device

- JB noted the *Hamnavoe* draught and asked if WM would have any concerns about the subsea devices. WM stated that they would not leave harbour in any conditions where wave heights could result in interaction with devices at -20m LAT.
- Very deep-draught vessels are the only ones likely to be at risk. AW stated that it would be very unlikely a large tanker would deviate from its normal route such as to be within Brims site (taking into account mitigation in not developing SE corner or ensuring additional clearance).
- The use of aids to navigation to mark the site was discussed. SD stated that buoyage was not desirable as the devices are well below the water and buoys could present an allision risk of their own. Furthermore SD highlighted the difficulty of ensuring buoys retained station in areas of strong tidal flows, such as Brims.

3.4.4 Passing vessel drifting allision with submerged device

- Average Flotta tanker is 10-12m, though a VLCC called in Scapa Flow in March 2015 with a draught of over 22m. Would only be likely to enter the area if it had suffered a breakdown, in which case turbines would be least of its worries, as it would be in danger of grounding on the coast. The most likely outcome would be a breakage of a rotor blade. ML noted that the OH device was relatively solid but agreed it would come off worst in any interaction with a VLCC.
- SD asked if turbines could be braked in a drifting scenario to maximize available underwater clearance. For the OpenHydro device this would not provide any additional clearance. Braking of open rotor devices was noted as potential mitigation, to be considered further in the ERCoP, but it would not be assumed in the modelling as it cannot be guaranteed to provide any additional clearance.
- MG asked about the control room. ML indicated this is likely to be on Hoy, but could be elsewhere. The test device at EMEC is monitored remotely.

3.4.5 Displacement of vessels due to avoidance of site leading to increased vessel to vessel collision risk

- WM stated that the potential for displacement due to avoidance of the site, leading to increased vessel to vessel collision risk, would be very minor due to the low level of traffic in and around the Brims development area.
- FM noted that if small fishing / recreational vessels deviated inshore of the AfL area due to the surface platforms they may encounter a higher level of fishing gear (e.g. creel ropes and marker buoys).
- MG queried if any effects on surface currents or tidal streams were expected. ML stated that modelling was currently being undertaken however noted that due to the depths at which devices would be installed the likelihood of any effect is expected to be very low. JB noted that previous studies for other tidal developments had concluded minimal impacts.

3.4.6 Fishing gear interaction with subsea equipment within site

- FM and AL stated that fishermen do not want to lose any gear due to the high costs associated with replacing it. In this area, fishing gear is set and visited every few days, noting that the ability to visit fishing gear is highly dependent on prevailing weather and tidal conditions. Gear is hauled once or twice per fortnight coinciding with periods of suitable weather and tide.
- FM felt that the development of the Brims AfL area was effectively creating an exclusion zone for most fishermen due to the risk of losing gear, which was noted as a commercial issue (to be covered under commercial fisheries chapter). FM stated that the final decision to fish or not within the development area rested with the skipper of the vessel, however, fishing activity could not be ruled out following construction. The area is currently a high risk area in terms of gear loss (due to strong tidal streams) however fishermen are willing to take the risk as it is financially rewarding.
- FM stated that engagement with local fishermen on all the issues was essential and face-to-face consultation was preferred. JB noted all the fishermen identified to use the area had been invited but it was understandable if they cannot attend due to work

commitments. They will however be sent the minutes for comment. It will be checked whether further local consultation is planned during the commercial fisheries work.

- FM further clarified in a post-meeting response that fishing, although at high risk to gear loss is currently carried out within the AfL area by a limited number of fishermen who factor in the financial rewards against the possible gear risks and have developed specific skills and knowledge for working there. The additions of subsea hazards would be most likely to end fishing within the AfL, a de facto closure. Even for those who currently risk fishing within the AfL fishing would most likely cease because of the increased operating dangers and increased gear loss risks. This would effectively be a closure whether decreed in name, legal status or not. It does not preclude the fact that commercial pressures may force some to attempt to fish within the site given the added risks.

3.4.7 Vessel anchoring on or dragging anchor over subsea equipment within site

- DS stated that vessels were not likely to anchor in the vicinity of the Brims AfL area due to water depths, stating that the weight of chain which would be required to anchor in these depths would present a safety risk.
- WM also added that many vessels were unlikely to carry enough chain to anchor in these depths and this hazard could effectively be dismissed as minimal risk.

3.4.8 Fishing gear interaction with export cable

- FM stated that the export cable has to be buried in order to minimise the risk of interaction with fishing gear. FM cited previous issues with a fibre optic cable linking Westray to the mainland, which was unprotected, and stated that lessons should be learned from this.
- ML stated that as the majority of the seabed in the area is scoured rock the export cable will need to be protected with concrete mattressing / rock dumping. FM re-iterated a preference for burial however indicated that if burial was not possible, local fishermen should be consulted to ensure that protection methods were as sympathetic to fishing as possible (e.g. creation of additional habitat within protection).
- JB noted the final cable route had not been selected and that it would normally be a consent condition to carry out a cable risk assessment of the final cable route to ensure adequate protection.
- MG queried if directional drilling was possible. ML stated that directional drilling was possible for a short distance from the shoreline, dependent on the final landfall chosen.

3.4.9 Vessel anchoring on or dragging anchor over export cable

- As noted in Section 3.4.7 the likelihood of a large vessel anchoring in the vicinity of the Brims AfL area was low.
- One landfall option, Aith Hope, is used as a mooring for local fishing vessels and occasionally as anchorage for recreational vessels. It was therefore noted that if the Aith Hope export cable route was selected the cable would require sufficient protection from fishing and recreational vessel anchoring.

3.4.10 Loss of device or component

- ML stated that OpenHydro have a lot of previous operational experience of the OpenHydro device from existing sites (e.g. EMEC Fall of Warness and Bay of Fundy, Canada, which are characterised by strong tides and Paimpol, France, which is characterised by heavy seas) which would stand them in good stead for the development of the Brims site.
- The phased development approach would also allow for a deploy and monitor strategy for a sub-set of devices to confirm their adequacy for the Brims site, in support of full scale development.
- DS asked if the devices had been independently verified. ML stated that OpenHydro design processes were DNV-certified, and that the OpenHydro device will be DNV-certified.
- MG queried if the OpenHydro device contained any buoyant components. ML stated that the device does contain buoyant parts but there are very limited scenarios which would result in these buoyant components breaking free and potentially posing a hazard. The consequences of an impact are likely to be higher for smaller, GRP-hulled recreational boats than larger, steel-hulled merchant vessels. SD stated that part of the function of the Emergency Response Cooperation Plan would be to detail the communication protocol to relevant parties, including the Coastguard and Orkney VTS, if a buoyant component were to break free.
- DS queried what the likely consequence would be if an external object, such as debris, which was noted as likely given the nature of the sea area, were to allide with a device. ML stated that the most likely consequence would be failure of the blades.
- ML stated that there would be a rolling maintenance program which will help identify any potential issues early on thus limiting the likelihood of device / component failure.
- ML indicated that the preferred location for the operational base is Lyness (tbc) but stated that there could be a vessel draught issue as the OpenHydro installation barge draught when fully loaded (10m) exceeds current water depths at Lyness. DS thought this issue could be resolved.
- DS stated that Orkney VTS would broadcast information about the development, despite it falling out with their area of responsibility.

3.4.11 Unauthorised entry to platform and / or deliberate damage

- Brief discussions were held on the likelihood of this event concluding that is was extremely unlikely due to the remote location of the site and difficulty in coming alongside isolated structures given the strong tidal streams.
- It is only a potential issue if surface-piercing elements are part of the final design.

3.4.12 Restricted search and rescue capability in an emergency situation

- Discussions were held and it was concluded that no significant impact on search and rescue capability is expected. The only potential issue raised was that the development could increase the burden on existing search and rescue resources. SB emphasised the requirement for a level of self-help and also stated that there was potential for the development to enhance the SAR capability with regards to responding to 3rd party incidents as per SOLAS.

3.4.13 Restricted oil spill response in a pollution incident

- DS stated that as there was not expected not to be any effect on the water surface there would be no significant impact on the oil spill response capability. Scrabster and Orkney Harbour Authorities already have an approved oil spill response plan.
- DS recommended carrying out combined drills and exercises involving the developer and Orkney Harbours to ensure adequate preparation for oil pollution incidents.
- ML confirmed there would only be very limited oil inventories used on-site.

3.5 Construction

3.5.1 Displacement of vessels due to avoidance of site / construction vessels leading to increased passing vessel to vessel collision risk

- WM confirmed that current methods of information promulgation (Notice to Mariners, issued by both Orkney VTS and UKHO) would be adequate for Northlink Ferries and therefore no need to specifically target information.
- SD highlighted the usefulness of a marine manager particularly with respect to the coordination of construction traffic routeing. ML confirmed that a marine manager had been employed at other OpenHydro sites.
- WM felt that safety zones should apply during the construction phase only. JB stated it was industry standard practice to have rolling safety zones which would only apply when necessary, i.e., work vessels on-site and restricted in manoeuvrability. This can be indicated using AIS and appropriate marks on the vessel. A blanket exclusion zone covering the whole site is unlikely to be acceptable. The application for safety zones is normally made post-consent, and pre-construction.

3.5.2 Collision between passing vessel and construction vessel (either at site or on route)

- MG stated that this should not be a major issue given that all vessels should comply with COLREGs in open seas during transit.
- DS highlighted the importance of vessel selection and auditing to minimise the risk.
- SD also stated that the Marine Manager would help as a focal point for communication between vessels.
- DS stated that Orkney VTS operate an advisory service within their jurisdiction. They do not instruct traffic but they can help control movements to avoid encounters, e.g., if there was a scenario with a VLCC outbound and a Brims workboat inbound. DS stated that current AIS and Radar coverage of the Brims site is very good and all vessel movements are recorded. CCTV is also present but visibility is limited by prevailing weather conditions.
- DS noted that although they do not have legal responsibility outside the Harbour Waters, they are very interested in the Brims project because it is in the approaches.

3.5.3 Dropped object

- FM stated a preference for "dry storage" (i.e. taking to land) over "wet storage" if any object had to be recovered.
- DS stated that some mariners see "wet storage" as a benefit as it reduces overall mileage and can be seen as safer.

3.5.4 Man overboard

- Concerns were again raised about increasing the burden on existing search and rescue resources. Emphasis was placed on the need for self-help as the primary means of response. This would include using personnel trained in offshore survival, suitable PPE and fast rescue craft.

3.6 Additional Hazards

- JB referred to a previous conversation with Magnus Norquoy (local fishermen) who had expressed concerns regarding decommissioning and whether devices would be fully removed. ML stated that a decommissioning plan is required to be agreed as part of the consent. The entire OpenHydro device (including GBS foundation) can be decommissioned. Other tidal devices which are piled into seabed shall be cut as close to the seabed as possible. SD was aware of other piles which had not been cut as close to seabed as desired. FM noted that the oil & gas industry had developed a decommissioning fund at the onset of the development and suggested that a similar fund could be developed for renewable energy.
- MG asked if surface-piercing substations would have a helideck, as it would allow an alternative means of access. ML stated that he was not 100% sure and would have to check.
- SB stated that during the summer traffic survey "coasteering" activity was recorded on the shoreline adjacent to the AfL area. IJ stated that this was associated with the Hoy Outdoor Centre but that they would not often travel to the south of Hoy. It was concluded that this was not an issue for the Brims Tidal Array as participants would remain very close to shore.
- JB stated that there had been mention of kayaking within the area during previous consultation. No other attendees were aware of the prevalence of kayaking activity. However, MG was aware of open sea swimmers attempting to cross the Pentland Firth. FM stated that only three individuals have completed this and that it was rarely attempted but when carried out Robert Smith uses his vessel as the support vessel.
- JB noted the *Welcome Home* sea angling vessel based in Stromness had been recorded once during the surveys in proximity to Brims. No diving vessels were recorded, which corroborated consultation with the (now defunct) Orkney Dive Boat Operators Association, which indicated dive vessels tend to stay in Scapa Flow and do not often head south of Hoy.

4. Hazard Ranking Methodology

The ranking of the risks associated with the various hazards was subsequently carried out based on the discussion at the Workshop and review of the baseline data and other consultation. This was circulated to attendees after the meeting for feedback. A risk matrix was used based on the frequency and consequence categories shown below.

Table 4.1 Frequency Bands

Rank	Description	Definition
1	Negligible	< 1 occurrence per 10,000 years
2	Extremely Unlikely	1 per 100 to 10,000 years
3	Remote	1 per 10 to 100 years
4	Reasonably Probable	1 per 1 to 10 years
5	Frequent	Yearly

Table 4.2 Consequence Bands

Rank	Description	Definition			
		People	Environment	Property	Business
1	Negligible	No injury	<£10k	<£10k	<10k
2	Minor	Slight injury(s)	Tier 1: Local assistance required	£10k-£100k	£10k-£100k
3	Moderate	Multiple moderate or single serious injury	Tier 2: Limited external assistance required	£100k-£1M	£100k-£1M Local publicity
4	Serious	serious injury or single fatality	Tier 2: Regional assistance required	£1M-£10M	£1M-£10M National publicity
5	Major	More than 1 fatality	Tier 3: National assistance required	>£10M	>£10M International publicity

The four consequence scores were averaged and multiplied by the frequency to obtain an overall ranking (or score) which determined the hazard's position within the risk matrix shown below.

Table 4.3 Risk Matrix

Consequence						
	5					
	4					
	3					
	2					
	1					
		1	2	3	4	5
		Frequency				

where:

	Broadly Acceptable Region (Low Risk)	Generally regarded as insignificant and adequately controlled. None the less the law still requires further risk reductions if it is reasonably practicable. However, at these levels the opportunity for further risk reduction is much more limited.
	Tolerable Region (Intermediate Risk)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate control measures are in place, residual risks are as low as is reasonably practicable (ALARP) and that risks are periodically reviewed to see if further controls are appropriate.
	Unacceptable Region (High Risk)	Generally regarded as unacceptable whatever the level of benefit associated with the activity.

The hazard was ranked by expected risk (based on the estimated frequency versus consequence) with no (or basic) mitigation measures applied, and residual risk following application of industry standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop.

5. Risk Rankings

The final hazard log contained 25 navigational hazards (due to several hazards being split by vessel type) with the following overall breakdown by tolerability region presented in Figure 5.1.

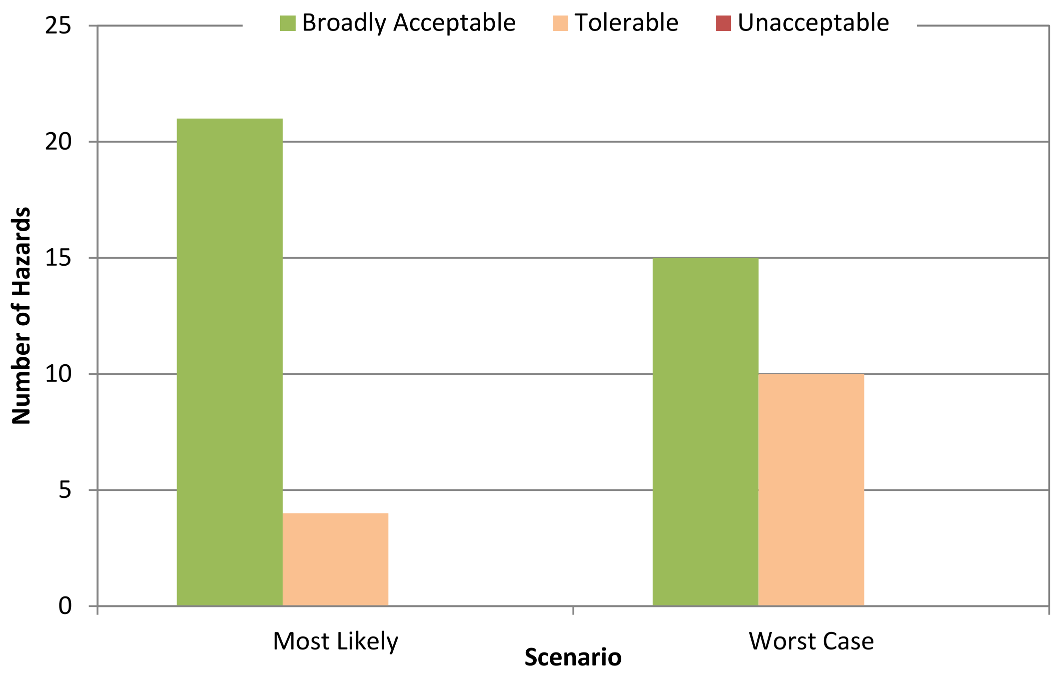

Figure 5.1 Brims Tidal Array Risk Ranking Results

No hazards were assessed as being unacceptable. The majority of hazards were assessed as being broadly acceptable both in the most likely scenario and in the worst case scenario. However there is still a requirement that risks are properly assessed and appropriate control measures are put in place to ensure residual risks are ALARP.

Full details of the logged and ranked hazards are summarised below.

ID	Phase	Hazard Title	Hazard Detail	Possible Causes	Embedded Mitigations	Most Likely Consequence (assuming embedded mitigations)	Realistic Worst Case Consequence (assuming embedded mitigations)	Most Likely						Worst Case						Additional Mitigations
								Frequency	People	Environment	Property	Business	Risk	Frequency	People	Environment	Property	Business	Risk	
1.1	Operation	Passing (**commercial**) vessel powered allision with surface platforms.	Due to the physical presence of the surface platforms there could be an increased risk of powered **commercial** vessel allisions with the structure.	Adverse weather Equipment failure Fatigue Human error Lack of awareness Lack of experience Lack of passage planning Manoeuvring error Navigational aid failure Poor visibility Watchkeeper failure	Charting of site ERCoP Issue Notice to Mariners / Navtex Marking and lighting Passage planning by vessels Ships ARPA radar & watchkeeping Up-to-date charts	Minor damage to vessel / surface platforms. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel / surface platforms resulting in severe damage and potentially fatalities. Serious environmental impact. Serious disruption to Brims operations.	3	2	1	2	1	5	2	4	4	4	4	8	Use of radar reflectors and AIS Aid to Navigation to increase conspicuity of surface platforms. Use of subsea hubs rather than surface-piercing platforms, if feasible.
1.2	Operation	Passing (**fishing**) vessel powered allision with surface platforms.	Due to the physical presence of the surface platforms there could be an increased risk of powered **fishing** vessel allisions with the structure.	Adverse weather Equipment failure Fatigue Human error Lack of awareness Lack of experience Lack of passage planning Manoeuvring error Navigational aid failure Poor visibility Watchkeeper failure	Charting of site ERCoP Issue Notice to Mariners / Navtex Kingfisher publications Marking and lighting Passage planning by vessels Vessel radar & watchkeeping Up-to-date charts	Minor damage to vessel / surface platforms. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel / surface platforms resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	3	3	1	3	1	6	2	5	2	3	4	7	Promulgation of information to local fishing organisations to ensure information is passed to local fishermen. Use of radar reflectors and AIS AtoN to increase conspicuity of surface platforms. Use of subsea hubs rather than surface-piercing platforms, if feasible.
1.3	Operation	Passing (**recreational**) vessel powered allision with surface platforms.	Due to the physical presence of the surface platforms there could be an increased risk of powered **recreational** vessel allisions with the structure.	Adverse weather Equipment failure Fatigue Human error Lack of awareness Lack of experience Lack of passage planning Manoeuvring error Navigational aid failure Poor visibility Watchkeeper failure	Charting of site ERCoP Issue Notice to Mariners / Navtex Marking and lighting Passage planning by vessels Up-to-date charts	Minor damage to vessel / surface platforms. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel / surface platforms resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	3	3	1	3	1	6	2	5	2	3	4	7	Additional promulgation of information to surrounding recreational marinas that may be called on before or during visits to Orkney. Details to be circulated to publishers of almanacs and sailing directions covering the area, e.g., Clyde Cruising Club. Use of radar reflectors to increase conspicuity of surface platforms. Use of subsea hubs rather than surface-piercing platforms, if feasible.
2.1	Operation	Passing (**commercial**) vessel drifting allision with surface platforms.	Due to the physical presence of the surface platforms there could be an increased risk of drifting **commercial** vessel allisions with the structure.	Adverse weather Deep water (not possible to anchor) Equipment failure Human error Lack of awareness Lack of experience Poor visibility	Charting of site ERCOP Issue Notice to Mariners / Navtex Marine coordination Marking and lighting Watchkeeping	Minor damage to vessel / surface platforms. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Serious environmental impact. Serious disruption to Brims operations.	2	2	1	2	1	3	1	4	4	4	4	4	Use of subsea hubs rather than surface-piercing platforms, if feasible. (Note: 'Herakles' ETV is currently stationed in Kirkwall but its presence is not guarantted by the time of development.)
2.2	Operation	Passing (**fishing**) vessel drifting allision with surface platforms.	Due to the physical presence of the surface platforms there could be an increased risk of drifting **fishing** vessel allisions with the structure.	Adverse weather Deep water (not possible to anchor) Equipment failure Human error Lack of awareness Lack of experience Poor visibility	Charting of site ERCOP Issue Notice to Mariners / Navtex Kingfisher publications Marine coordination Marking and lighting Watchkeeping	Minor damage to vessel / surface platforms. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	3	3	1	3	1	6	2	5	2	3	4	7	Orkney harbour tugs located nearby with potential to tow drifting vessel. Use of subsea hubs rather than surface-piercing platforms, if feasible.

ID	Phase	Hazard Title	Hazard Detail	Possible Causes	Embedded Mitigations	Most Likely Consequence (assuming embedded mitigations)	Realistic Worst Case Consequence (assuming embedded mitigations)	Most Likely Frequency	Most Likely People	Most Likely Environment	Most Likely Property	Most Likely Business	Most Likely Risk	Worst Case Frequency	Worst Case People	Worst Case Environment	Worst Case Property	Worst Case Business	Worst Case Risk	Additional Mitigations
2.3	Operation	Passing (**recreational**) vessel drifting allision with surface platforms.	Due to the physical presence of the surface platforms there could be an increased risk of drifting **recreational** vessel allisions with the structure.	Adverse weather Deep water (not possible to anchor) Equipment failure Human error Lack of awareness Lack of experience Poor visibility	Charting of site ERCOP Issue Notice to Mariners / Navtex Marine coordination Marking and lighting Watchkeeping	Minor damage to vessel / surface platforms. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	3	3	1	3	1	6	2	5	2	3	4	7	Orkney harbour tugs located nearby with potential to tow drifting vessel. Use of subsea hubs rather than surface-piercing platforms, if feasible.
3.1	Operation	Passing (**commercial**) vessel powered allision with submerged tidal device.	Due to the physical presence of the subsea tidal devices there could be an increased risk of powered **commercial** vessel allisions with the structures.	Adverse weather Equipment failure Fatigue Human error Insufficient under keel clearance Lack of awareness Lack of experience Lack of passage planning	Charting of site Design under water clearance (minimum -20m LAT) ERCoP Issue Notices to Mariners / Navtex Kingfisher publications Liaison with recreational sailors Marine coordination Up-to-date charts	Minor damage to vessel / tidal device. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Serious environmental impact. Serious disruption to Brims operations.	2	2	1	2	1	3	1	4	4	4	4	4	Avoid developing SE corner of site where large tankers to/from Scapa Flow may transit. Alternatively, have additional under water clearance in this area.
3.2	Operation	Passing (**fishing**) vessel powered allision with submerged tidal device.	Due to the physical presence of the subsea tidal devices there could be an increased risk of powered **fishing** vessel allisions with the structures. (Note: The minimum designed under water clearance makes this very unlikely.)	Adverse weather Equipment failure Fatigue Human error Insufficient under keel clearance Lack of awareness Lack of experience Lack of passage planning	Charting of site Design under water clearance (minimum -20m LAT) ERCoP Issue Notices to Mariners / Navtex Kingfisher publications Liaison with recreational sailors Marine coordination Up-to-date charts	Minor damage to vessel / tidal device. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	1	3	1	3	1	2	1	5	2	3	4	4	
3.3	Operation	Passing (**recreational**) vessel powered allision submerged tidal device.	Due to the physical presence of the subsea tidal devices there could be an increased risk of powered **recreational** vessel allisions with the structures. (Note: The minimum designed under water clearance makes this very unlikely.)	Adverse weather Equipment failure Fatigue Human error Insufficient under keel clearance Lack of awareness Lack of experience Lack of passage planning	Charting of site Design under water clearance (minimum -20m LAT) ERCoP Issue Notices to Mariners / Navtex Kingfisher publications Liaison with recreational sailors Marine coordination Up-to-date charts	Minor damage to vessel / tidal device. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	1	3	1	3	1	2	1	5	2	3	4	4	
4.1	Operation	Passing (**commercial**) vessel drifting allision with submerged tidal device.	Due to the physical presence of the subsea tidal device there could be an increased risk of drifting **commercial** vessel allisions with the structure.	Adverse weather Deep water (not possible to anchor) Equipment failure Human error Insufficient under keel clearance Lack of awareness Lack of experience Poor visibility	Charting of site Design under water clearance (minimum -20m LAT) ERCOP Issue Notice to Mariners / Navtex Marine coordination Tug availability Watchkeeping	Minor damage to vessel / tidal device. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Serious environmental impact. Serious disruption to Brims operations.	1	2	1	2	1	2	1	4	4	4	4	4	Avoid developing SE corner of site where large tankers to/from Scapa Flow may transit. Alternatively, have additional under water clearance in this area.
4.2	Operation	Passing (**fishing**) vessel drifting allision with submerged tidal device.	Due to the physical presence of the subsea tidal device there could be an increased risk of drifting **fishing** vessel allisions with the structure. (Note: The minimum designed under water clearance makes this very unlikely.)	Adverse weather Deep water (not possible to anchor) Equipment failure Human error Insufficient under keel clearance Lack of awareness Lack of experience Poor visibility	Charting of site Design under water clearance (minimum -20m LAT) ERCOP Issue Notice to Mariners / Navtex Marine coordination Tug availability Watchkeeping	Minor damage to vessel / tidal device. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	1	3	1	3	1	2	1	5	2	3	4	4	Promulgation of information to local fishing organisations to ensure information is passed to local fishermen. Orkney harbour tugs located nearby with potential to tow drifting vessel.

ID	Phase	Hazard Title	Hazard Detail	Possible Causes	Embedded Mitigations	Most Likely Consequence (assuming embedded mitigations)	Realistic Worst Case Consequence (assuming embedded mitigations)	Most Likely: Frequency	Most Likely: People	Most Likely: Environment	Most Likely: Property	Most Likely: Business	Most Likely: Risk	Worst Case: Frequency	Worst Case: People	Worst Case: Environment	Worst Case: Property	Worst Case: Business	Worst Case: Risk	Additional Mitigations
4.3	Operation	Passing (**recreational**) vessel drifting allision submerged tidal device.	Due to the physical presence of the subsea tidal device there could be an increased risk of drifting **recreational** vessel allisions with the structure. (Note: The minimum designed under water clearance makes this very unlikely.)	Adverse weather Deep water (not possible to anchor) Equipment failure Human error Insufficient under keel clearance Lack of awareness Lack of experience Poor visibility	Charting of site Design under water clearance (minimum -20m LAT) ERCOP Issue Notice to Mariners / Navtex Marine coordination Tug availability Watchkeeping	Minor damage to vessel / tidal device. Minor injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possibly resulting in fatality. Moderate environmental impact. Serious disruption to Brims operations.	1	3	1	3	1	2	1	5	2	3	4	4	Additional promulgation of information to surrounding recreational marinas that may be called on before visiting Orkney. Orkney harbour tugs located nearby with potential to tow drifting vessel.
5	Operation	Displacement of vessels due to avoidance of site leading to increased passing vessel-to-vessel collision. (Mainly an issue for surface-piercing elements.)	Displaced traffic increases congestion outside of the site leading to increased vessel to vessel collision risk.	Communication failure Failure to comply with Colregs Fatigue Human Error Increased vessel density Lack of awareness Lack of experience Lack of passage planning Poor visibility Watchkeeper failure.	AIS fitted on all workboats working within site Compliance with Colregs Continuous watch by multi-channel VHF, including DSC Control of working traffic ERCoP Fisheries Liaison Issue Notices to Mariners/NAVTEX Kingfisher publications Liaison with Recreational Sailors Marine coordination Passage planning by vessels Ships ARPA radar & watchkeeping Watchkeeping	Minor damage to vessels. Minor injuries to crew members. Minor environmental impact. Negligible disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possible resulting in fatality. Serious environmental impact. Serious disruption to Brims operations.	2	2	2	2	1	4	1	5	3	3	2	3	Appointment of marine manager to coordinate work vessel movements. Use of subsea hubs rather than surface-piercing platforms, if feasible.
6	Operation	Fishing gear interaction with subsea equipment within site.	Fishing vessel gear snags on subsea equipment within site.	Failure to promulgate information Equipment failure Fishing vessels attracted to site Human error Lack of awareness Lack of experience	Abandon gear Charting of site ERCoP Fisheries liaison Issue to Notices to Mariners / Navtex Kingfisher publications Marking and lighting Notices to Fishermen Up-to-date charts	Fishing vessel loses gear and suffers disruption to fishing operations. No injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Fishing vessel snags and loses stability resulting in the vessel foundering. Loss of life. Minor environmental impact. Major disruption to Brims operations.	4	2	2	1	1	6	2	5	3	2	4	7	Promulgation of information to local fishing organisations to ensure information is passed to local fishermen.
7	Operation	Vessel anchoring on or dragging anchor over subsea equipment within site.	Vessel may anchor over subsea equipment within site or a nearby vessel at anchor may drag its anchor over subsea structure.	Adverse weather Equipment failure Failure to promulgate information Human error Incident in proximity to site Lack of awareness Navigation aid failure (if present) Poor holding ground	No anchoring in area due to water depth Contingency planning for weather Charting of site ERCoP Kingfisher publications Notice to Mariners Up-to-date charts	Dropped anchor causes minor damage to subsea structure: minor impact on Brims operations. Negligible environmental impact. No impact on vessel.	Dropped anchor causes major damage to subsea structure: major impact on Brims operations. Vessel becomes snagged on subsea equipment.	1	2	1	2	2	2	1	3	4	4	4	4	
8	Operation	Fishing gear interaction with export cable.	Fishing vessel gear snags on export cable.	Failure to promulgate information Equipment failure Fishing vessels attracted to cable route Human error Lack of awareness Lack of experience	Abandon gear Cable protection Charting of site Communications with fishermen Fisheries liaison Issue to Notices to Mariners / Navtex Kingfisher publications Marking and lighting Notices to Fishermen Up-to-date charts	Fishing vessel loses gear and suffers disruption to fishing operations. No injuries to crew members. Negligible environmental impact. Minor disruption to Brims operations.	Fishing vessel snags and loses stability resulting in the vessel foundering. Loss of life. Minor environmental impact. Major disruption to Brims operations.	4	2	2	1	1	6	2	5	3	2	4	7	Promulgation of information to local fishing organisations to ensure information is passed to local fishermen. Cable risk assessment to be conducted on finalised route to identify suitable protection taking into account nature of seabed and fishing activity.
9	Operation	Vessel anchoring on or dragging anchor over export cable.	Vessel may anchor over export cable or a nearby vessel at anchor may drag its anchor over export cable.	Adverse weather Equipment failure Failure to promulgate information Human error Incident in proximity to site Lack of awareness Navigation aid failure (if present) Poor holding ground	Cable protection Charting of site Contingency planning for weather ERCoP Kingfisher publications Marine operating procedures Notice to Mariners Up-to-date charts	Dropped anchor causes no damage to export cable: minor impact on Brims operations. Negligible environmental impact. No impact on vessel.	Dropped anchor causes major damage to export cable: major impact on Brims operations. Vessel becomes snagged on export cable.	1	2	1	2	2	2	1	3	4	4	4	4	Cable risk assessment to be conducted on finalised route to identify suitable protection taking into account nature of seabed and any anchoring activity.

ID	Phase	Hazard Title	Hazard Detail	Possible Causes	Embedded Mitigations	Most Likely Consequence (assuming embedded mitigations)	Realistic Worst Case Consequence (assuming embedded mitigations)	Most Likely						Worst Case						Additional Mitigations
								Frequency	People	Environment	Property	Business	Risk	Frequency	People	Environment	Property	Business	Risk	
10	Operation	Loss of tidal device (e.g. breaks free) or part of tidal device (e.g. component failure).	Tidal device breaks free and / or part of tidal devices breaks free.	Adverse weather Equipment failure	Alerting system Components would mostly sink Onshore control room Design & testing (DNV-certified) ERCoP Phased approach (deploy and monitor) Regular maintenance SCADA	Component of tidal device breaks free and sinks to seabed. Negligible impact on vessel operations. Minor environmental impact. Moderate impact on Brims operations.	Component of tidal device breaks free and is buoyant presenting collision risk. Moderate impact on vessel operations. Minor environmental impact. Major impact on Brims operations.	4	1	1	2	2	6	2	4	1	4	4	7	Orkney VTS will liaise with Coastguard and navigational warnings will be broadcast.
11	Operation	Unauthorised entry to surface platforms and / or deliberate damage.	Vessels moor to the surface platforms without the authority to do so and / or the intention to vandalise / cause damage.	Vandalism Vessel attracted to site (curiosity)	Design under water clearance (minimum -20m LAT) ERCoP	Minor damage to vessel / surface platforms. Minor disruption to Brims operations.	Damage to surface platforms resulting in major disruption to Brims operations.	1	2	1	2	2	2	1	2	1	4	4	3	Use of subsea hubs rather than surface-piercing platforms, if feasible.
12	Operation	Restricted search and rescue capability in an emergency situation.	Restricted search and rescue capability in an emergency situation due to presence of Brims.	Incident in proximity to development	Design under water clearance (minimum -20m LAT) ERCoP Onsite assistance from workboats in area Personal Protective Equipment Site personnel suitably trained	Restricted search and rescue (i.e. vessels may have to go slower than normal)	Vessel sinking, loss of life, collision between search and rescue vessel and Brims structure.	2	2	2	2	2	4	1	4	1	5	5	4	Use of subsea hubs rather than surface-piercing platforms, if feasible.
13	Operation	Restricted oil spill response in a pollution incident.	Restricted oil spill response capability in a pollution incident due to presence of Brims.	Incident in proximity to development	Design under water clearance (minimum -20m LAT) ERCoP	Restricted oil spill response (i.e. impact on containment of spill / spraying of dispersants)	High tier pollution incident, major environmental impact and long term impact.	2	1	3	3	3	5	1	3	5	5	5	5	Coordination with local harbour to carry out combined drills / exercises.
14	Construction	Displacement of vessels due to avoidance of site / construction vessels leading to increased passing vessel to vessel collision.	Displaced traffic increases congestion outside of the construction area leading to increased vessel to vessel collision risk.	Communication failure Failure to comply with Colregs Fatigue Human Error Increased vessel density Lack of awareness Lack of experience Lack of passage planning Poor visibility Safety zones (up to 500m) Watchkeeper failure	AIS fitted on all workboats working within site Compliance with Colregs Construction zone on chart Continuous watch by multi-channel VHF, including DSC; Control of working traffic Emergency Response Cooperation Plan Fisheries Liaison Issue Notices to Mariners/NAVTEX Kingfisher publications Liaison with Recreational Sailors Marine coordination Passage planning by vessels Rolling safety zones only applicable during work on site Ships ARPA radar & watchkeeping Up-to-date charts Vessel traffic monitoring Watchkeeping	Minor damage to vessels. Minor injuries to crew members. Minor environmental impact. Negligible disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possible resulting in fatality. Serious environmental impact. Serious disruption to Brims operations.	3	2	2	2	1	5	1	5	3	3	2	3	Appointment of marine manager to coordinate construction traffic movements. Liaison with Orkney VTS.
15	Construction	Collision between passing vessel and construction vessel (either at site or on route).	Increased vessel to vessel collision risk due to presence of construction vessels (both on site and on route to / from site).	Adverse weather Communication failure Equipment failure Failure to comply with Colregs Fatigue Human Error Lack of awareness Lack of experience Lack of passage planning Manoeuvring error Poor visibility Watchkeeper failure	AIS fitted on all workboats working within site CDM regulations Communications with fishermen Compliance with Colregs Construction zone on chart Continuous watch by multi-channel VHF, including DSC Control of working traffic ERCoP Issue Notices to Mariners / Navtex Kingfisher publications Liaison with recreational sailors Marine Operating Procedures Navigational information broadcasts NAVTEX Notice to Mariners Passage planning Safety zones during work on site Ships ARPA radar & watchkeeping Site personnel suitably trained	Minor damage to vessels. Minor injuries to crew members. Minor environmental impact. Negligible disruption to Brims operations.	Penetration damage to vessel resulting in severe damage. Possible resulting in fatality. Serious environmental impact. Serious disruption to Brims operations.	3	2	2	2	1	5	2	5	3	3	3	7	Appointment of marine manager to coordinate construction traffic movements. Enhanced vessel selection and auditing. Liaison with Orkney VTS.
16	Construction	Dropped Object	Dropped object into the sea during construction activities.	Human error Equipment failure Inadequate work procedures Inadequate maintenance	Control of working traffic ERCoP Marine operating procedures Maritime Safety Information broadcasts Safety management system Site personnel suitably trained	Small object dropped and sinks to seabed. Negligible impact on vessel operations. Negligible environmental impact. Negligible impact on Brims operations.	Large buoyant object dropped and becomes drifting object. Strikes passing vessel resulting in possible major consequence. Moderate impact on Brims operations.	4	1	1	1	1	4	1	4	3	3	3	3	Wet storage to be minimised.
17	Construction	Man Overboard	Man overboard during construction activities.	Adverse weather Human error Fatigue	ERCoP Personal Protective Equipment Training	Man overboard during construction activities, recovered quickly, minor impact on Brims operations.	Man overboard during construction activities, potential for loss of life. Major impact on Brims operations.	4	2	1	1	2	6	1	4	1	2	5	3	Fast response craft onboard construction vessel.

Summary of PHA AIS Survey Data
Brims Tidal Array
(Appendix B)

Prepared by:	Anatec Limited
Presented to:	Brims Tidal Array Limited
Date:	20 August 2015
Revision No.:	01
Ref.:	A2455-BTAL-NRA-1-App B

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1. AIS Analysis

This Appendix presents the AIS data used in the Preliminary Hazard Analysis. Analysis was carried out on two separate 28 day periods in summer and winter 2010.

Plots of all the tracks recorded within 5nm of the AfL area during the summer and winter periods, colour-coded by vessel type, are presented in Figure 1.1 and Figure 1.2, respectively.

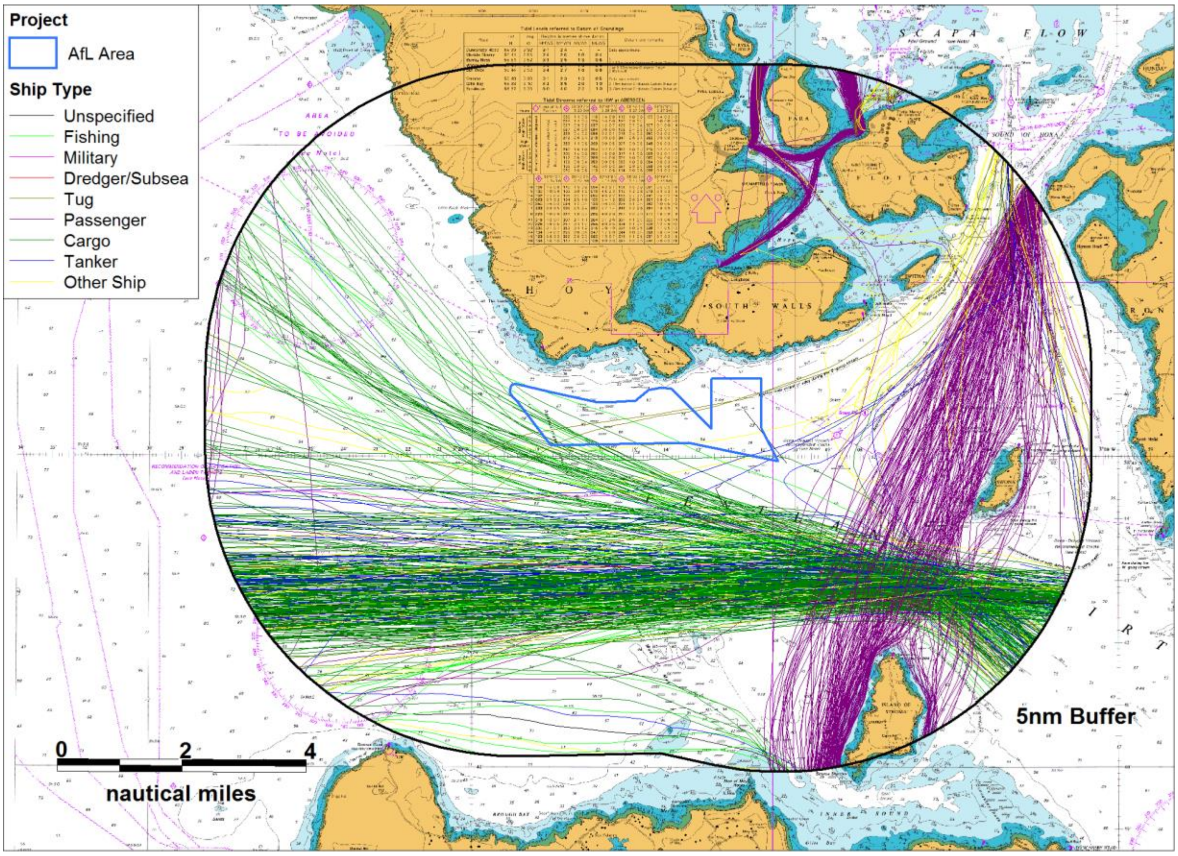

Figure 1.1 AIS Tracks by Type – 28 Days in Summer 2010

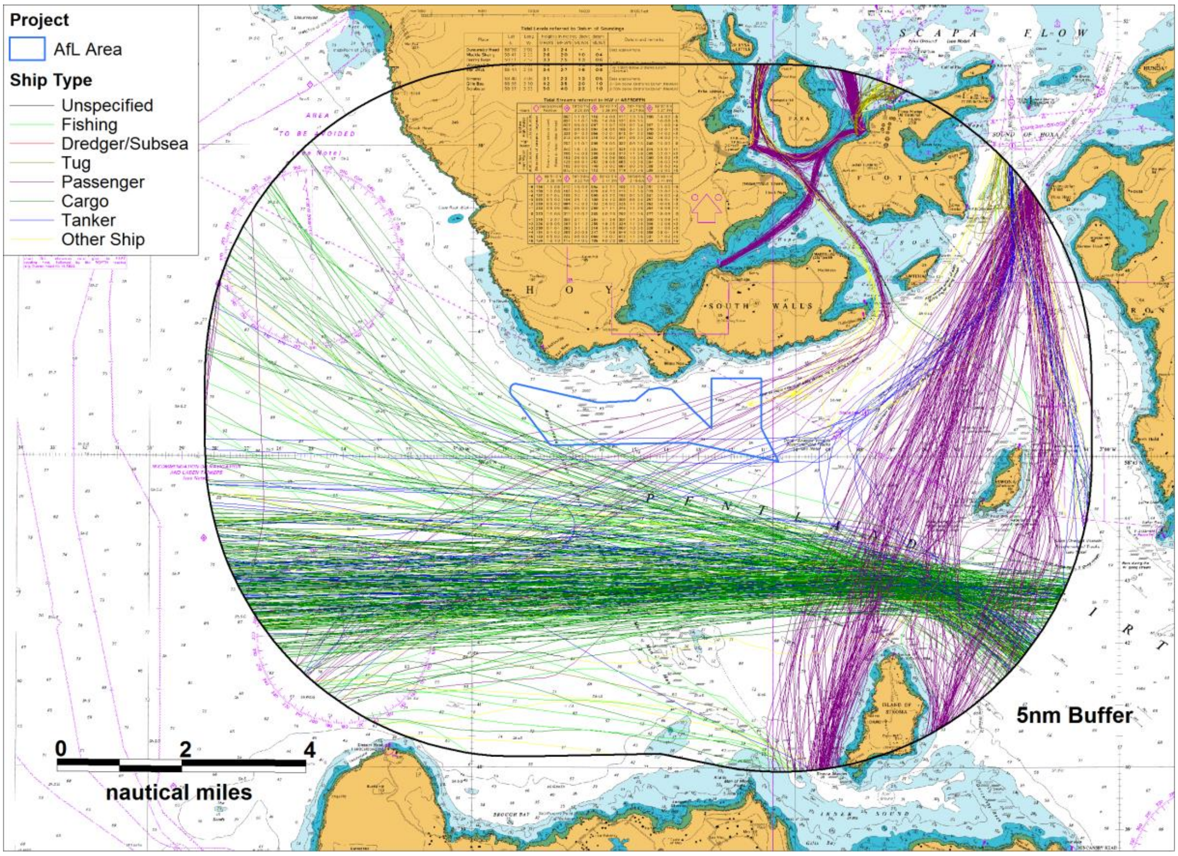

Figure 1.2 AIS Tracks by Type – 28 Days in Winter 2010

During the summer period there was an average of 20 unique vessels per day passing within 5nm, with a maximum of 32 on the busiest day, 17th July 2010. Twenty-two vessels were recorded intersecting the AfL area during the survey. On average 1 to 2 vessels per day were crossing the AfL area, with majority of tracks being cargo (54%) and fishing vessels (18%).

In the winter period, an average of 18 unique vessels per day were tracked within 5nm, with 27 on the busiest day, 14th November 2010. In the winter period, an average of 18 unique vessels per day were tracked within 5nm, with 27 on the busiest day. Twenty-four vessels were recorded intersecting the AfL area during the survey. On average 1 to 2 vessels per day were crossing the AfL area, with majority of tracks being passenger ferries (42%) and cargo vessels (29%).

Figure 1.3 presents the ship type distribution (excluding 1% unspecified in each period) within 5nm of the AfL area.

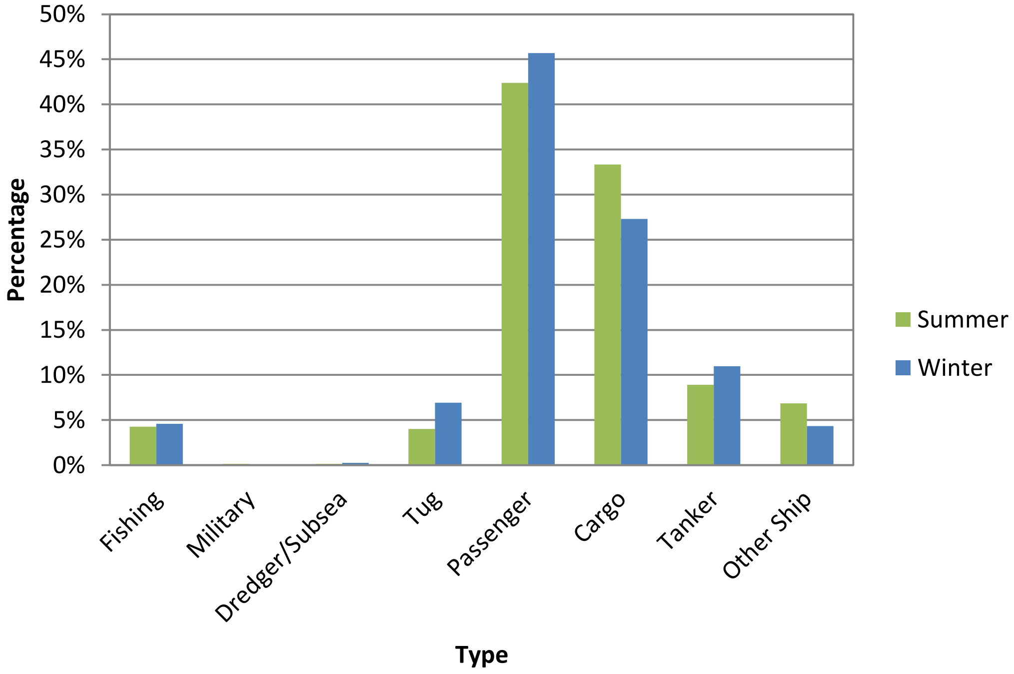

Figure 1.3 Vessel Types identified in proximity to the AfL Area

Overall, 44% of vessels identified during the combined survey period (summer and winter 2010) were passenger vessels. The majority of the passenger vessel tracks were made by the *Pentalina* which transited east of the AfL area between Gills Bay in Caithness and St Margaret's Hope on Orkney, making typically 3 return trips per day. The *Hamnavoe* ferry was also tracked crossing the former AfL area when routeing between Scrabster and Stromness via Scapa Flow, particularly in winter. The normal route is west of Hoy and via Hoy Mouth with the alternative route via Scapa Flow being taken for the comfort of passengers, particularly when heading northbound to Stromness during strong westerlies and ebb tide.

Approximately 30% of vessels were cargo ships, the vast majority transiting through the Outer Sound of the Pentland Firth.

Plots of the tracks within 5nm of the AfL area during summer and winter, colour coded by vessel length and vessel draught, are presented in Figure 1.4 to Figure 1.7.

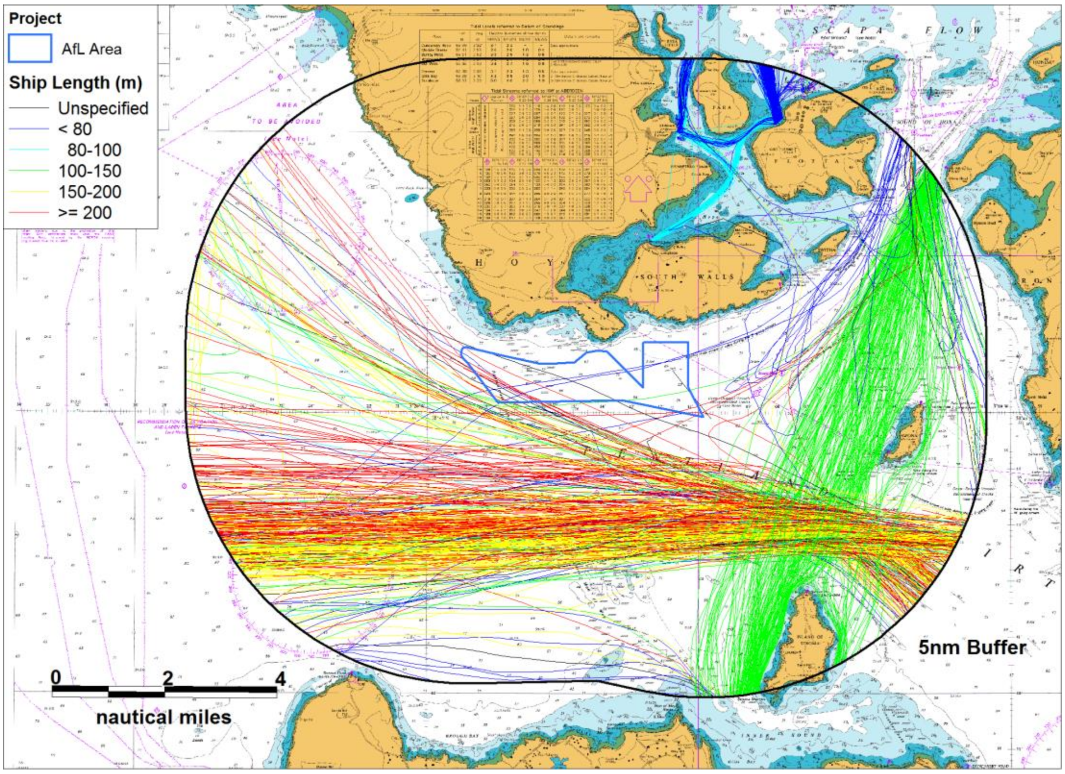

Figure 1.4 Summer 2010 AIS Tracks by Length

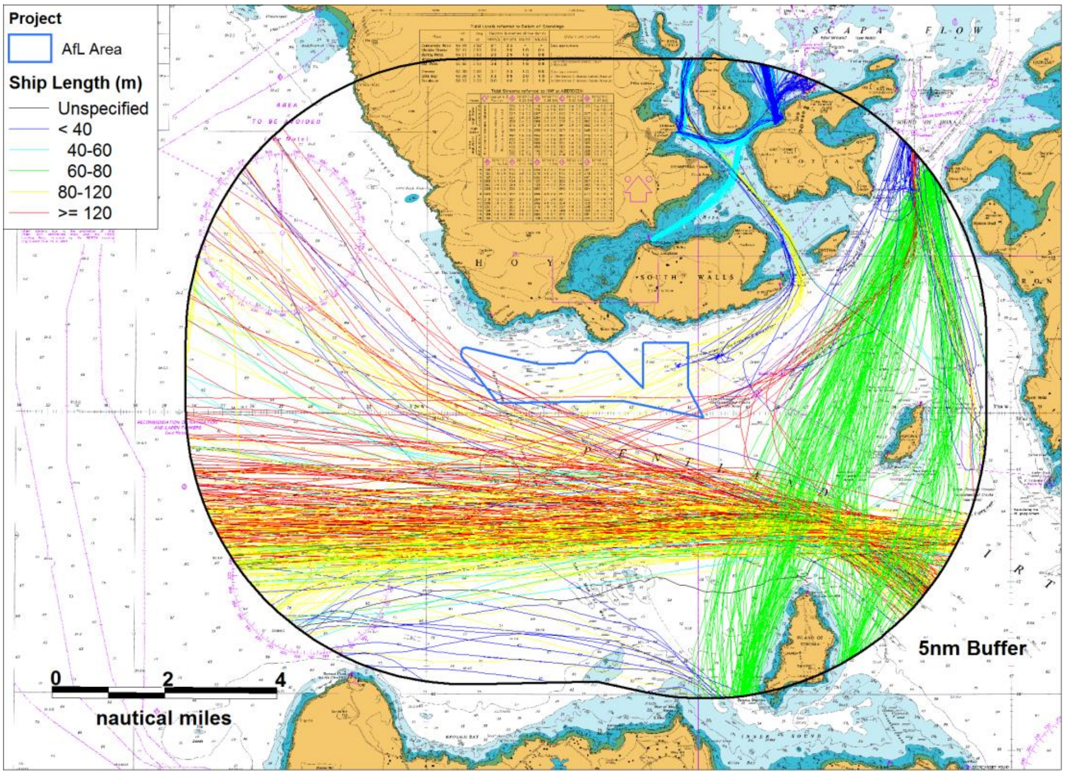

Figure 1.5 Winter 2010 AIS Tracks by Length

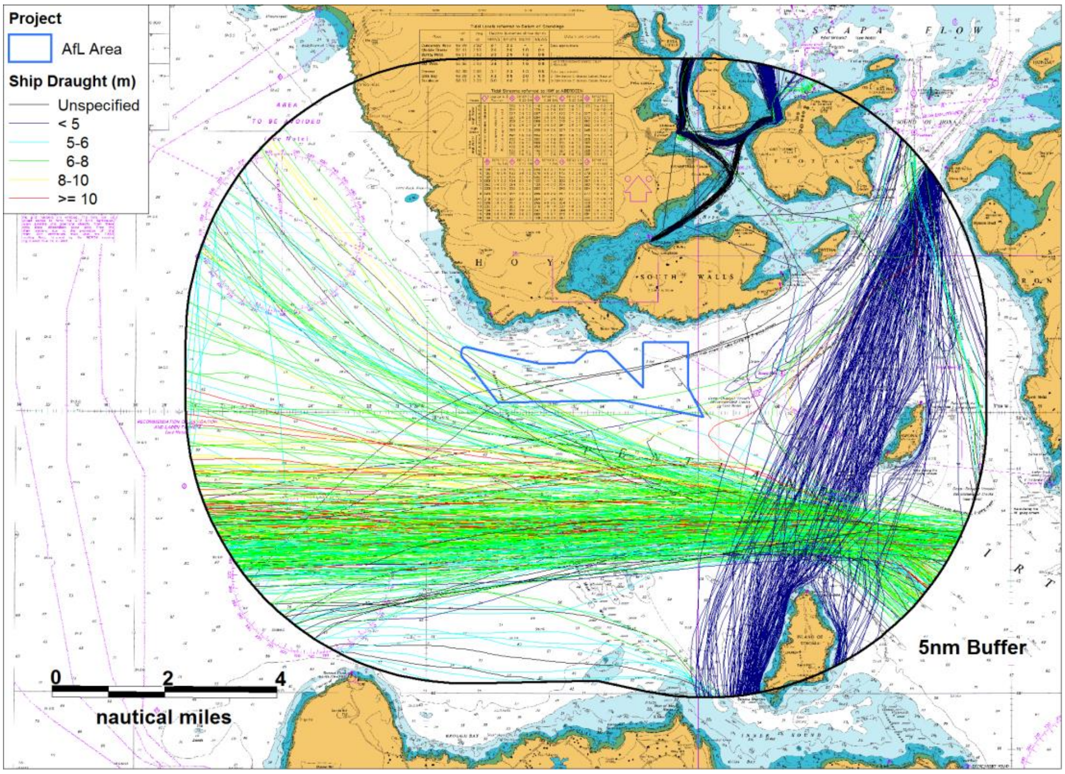

Figure 1.6 Summer 2010 AIS Tracks by Draught

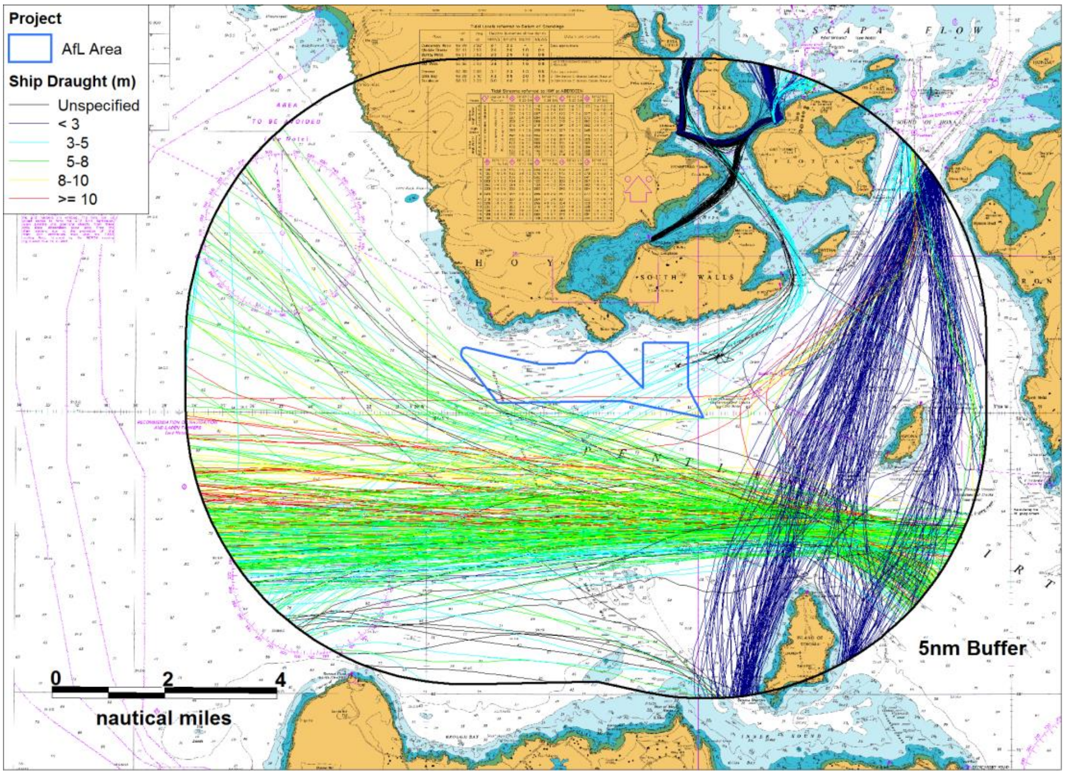

Figure 1.7 Winter 2010 AIS Tracks by Draught

In the summer period, the longest vessels were the container ships *OOCL Montreal* at 294m, bound for Montreal transiting the Outer Sound between Montreal and Hamburg. The container vessel *OOCL Montreal* was also the longest vessel recorded during the winter survey, tracked three times transiting the Outer Sound.

The deepest draught vessel during the summer survey was the tanker *Navion Europa*, at 15.8m, bound for Rotterdam and transiting east of the AfL area of search. The bulk carrier *Yeoman Bridge*, with a draught of 14m, was the deepest draught vessel tracked during the winter period, transiting through the Outer Sound to Isle of Grain, UK.

Other large vessels included tankers associated with the Flotta Oil Terminal identified to be using the recommended channels in and out of Scapa Flow.

MCA MGN 371 Checklist
Brims Tidal Array
(Appendix C)

Prepared by:	Anatec Limited
Presented to:	Brims Tidal Array Limited
Date:	20 August 2015
Revision No.:	01
Ref.:	A2455-BTAL-NRA-1 App C

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1. Introduction

This Annex presents the Maritime and Coastguard Agency (MCA) checklist based on the requirements set out in Marine Guidance Note (MGN) 371 which was the guidance set by the MCA during the NRA preparation.

Reference notes/remarks made within Table 1 in Section 2 are based on which sections of the Navigational Risk Assessment or other documents, address the issue noted in the MGN 371 checklist.

2. MGN 371 Compliance Checklist

Table 2.1 MGN 371 Compliance Checklist for the Brims Tidal Array

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
Annex 1 : Considerations on Site Position, Structures and Safety Zones			
1. Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed variations in the co-ordinates of site perimeters and individual OREI structures are made available, on request, to interested parties at all project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided in latitude/ longitude formats.			
2. Traffic Survey			
All vessel types	✓		***Section 3: Data Sources.*** *Tracking of all vessel types was achieved by analysis of AIS data and radar surveys.*
Four weeks duration, within 24 months prior to submission of the Environmental Statement	✓		***Section 3: Data Sources.*** *Survey period comprised of 2 x 14 Days shore based radar and AIS surveys and an additional 2 x 28 Days AIS data. Radar and AIS: 14 Days Winter 2013; 14 Days Summer 2014. AIS:28 Days Summer 2010; 28 Days Winter 2010.* ***Section 9: Maritime Traffic Surveys.*** *The periods covered encompass seasonal fluctuations in shipping activity and account for a range of tidal conditions.*
Seasonal variations	✓		***Section 3: Data Sources.*** *Surveys have been carried out in summer and winter to take account of seasonal variations in traffic patterns.*
Recreational and fishing vessel organisations	✓		***Section 3: Data Sources.*** *The periods chosen were designed to cover seasonal variations including small vessel activity variations.*
Port and navigation authorities	✓		***Section 3: Data Sources.*** *Surveys have been carried out in summer and winter to take account seasonal variations in traffic patterns.*
Assessment			
a. Proposed OREI site relative to	✓		***Section 9: Maritime Traffic Surveys.***

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
areas used by any type of marine craft.			*Summarises the results of the Maritime Traffic Surveys and visual observations.* ***Section 11: Fishing Vessel Activity.*** *Reviews fishing vessel activity in the area based on the Maritime Traffic Surveys, Marine Scotland surveillance (sightings and satellite) data, Crown Estate Succorfish data, Marine Scotland ScotMap data, research work reported in the Commercial Fisheries Chapter, and consultation undertaken at all stages of the Project and at the Hazard Review Workshop.* ***Section 12: Recreational Vessel Activity.*** *Examines recreational vessel activity in the area based on the Maritime Traffic Survey, RYA data, Marine Scotland Shipping Study, additional desktop information, and consultation undertaken at all stages of the Project and at the Hazard Review Workshop.* ***Section 10: Other Shipping Activity.*** *Examines activity by cargo, tanker, passenger, military and other vessels based on the Maritime Traffic Survey and consultation.*
b. Numbers, types and sizes of vessels presently using such areas	✓		***Sections 9, 10, 11 and 12 as listed in point a above.***
c. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, etc.	✓		***Section 13: Consultation.*** *Non-transit uses of the area discussed during stakeholder consultation.* ***Sections 9, 10, 11 & 12 as listed in point a above.***
d. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓		***Section 5: Existing Environment.*** *Based on review of Admiralty Charts.* ***Section 9: Maritime Traffic Surveys.*** *Determines whether these areas contain transit routes used by coastal or deep-draught vessels on passage, by examination of draught details in Maritime Traffic Survey data.*
e. Alignment and proximity of the site relative to adjacent shipping lanes.	✓		***Section 9: Maritime Traffic Surveys.*** *Identifies and assesses the alignment and proximity of the sites relative to adjacent shipping lanes, by analysis of Marine Traffic Survey data.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
f. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓		***Section 5: Existing Environment.*** *Based on review of Admiralty Charts and IMO Ship Routeing report.* ***Section 9: Maritime Traffic Surveys.*** *Determines whether vessels follow prescribed routeing schemes and avoid precautionary areas by examination of vessel tracks.*
g. Whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes.	✓		***Section 5: Existing Environment.*** *Reviews prescribed zones based on Admiralty Charts and IMO Ship Routeing report.* ***Section 9: Maritime Traffic Surveys.*** *Reviews actual traffic behaviour based on real-time data.*
h. Proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas.	✓		***Section 5: Existing Environment.*** *Examines the proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas, from analysis of Admiralty Charts and Sailing Directions (NP 52). It was established the site is in proximity to the SW entrance to Scapa Flow.* ***Section 9: Maritime Traffic Surveys.*** *Reviews actual traffic behaviour based on real-time data.*
i. Whether the site lies within port limits, etc. jurisdiction of a port and/or navigation authority.	✓		***Section 5: Existing Environment.*** *Establishes the AfL area partially overlaps the limits of jurisdiction of Orkney Harbours based on information from Admiralty Charts and Sailing Directions (NP 52).*
j. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓		***Section 11: Fishing Vessel Activity.*** *Reviews fishing vessel activity in the area based on the Maritime Traffic Surveys, Marine Scotland surveillance (sightings and satellite) data, Crown Estate Succorfish data, Marine Scotland ScotMap data, research work reported in the Commercial Fisheries Chapter, and consultation undertaken at all stages of the Project and at the Hazard Workshop.*
k. Proximity of the site to offshore firing/bombing ranges and areas used for any marine	✓		***Section 5: Existing Environment.*** *Analysis of Admiralty Charts, Admiralty Sailing Directions NP 52 and PEXA Charts*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
military purposes.			*to determine proximity to military areas.*
l. Proximity of the site to existing or proposed offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, or other exploration/exploitation sites	✓		***Section 5: Existing Environment.*** *Uses Admiralty Charts and published oil & gas infrastructure data to assess proximity to oil / gas platforms.* *Analyses GIS files based on published data from The Crown Estate to determine proximity to marine aggregate dredging sites.* *Analysed Hydrographic Charts for positions of wrecks in the area.*
m. Proximity of the site relative to any designated areas for the disposal of dredging spoil	✓		***Section 5: Existing Environment.*** *Examined positions of dredging spoil grounds taken from Hydrographic Charts.*
n. Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.	✓		***Section 5: Existing Environment.*** *Used Admiralty Sailing Directions NP 52 to determine proximity to Orkney Harbours VTS based at Scapa.* *Examined Admiralty Charts and Sailing Directions for positions of navigational aids.*
o. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density.	✓		***Section 16: Risk Modelling and Assessment.*** *Assessed present-day vessel activity and future-case with Project activity. Considered that displacement effect during normal operations will be minimal due to the 30m design clearance below LAT. (Separate review carried out of construction activities.).*
p. Type(s) of simulation used in analysis Limitation of system(s)	✓		***Section 16: Risk Modelling and Assessment.*** *All the quantified risk assessments were carried out using Anatec's COLLRISK software which conforms to the DECC methodology. In line with this, Anatec makes the declaration that the models used within this work have been validated and are appropriate for the intended use.*
3. OREI Structures			
a. Whether any features of the OREI, including auxiliary platforms outside the main generator site and cabling to the shore, could pose any type of	✓		***Section 4: Project Description Details.*** *Outlines the Rochdale (Design) Envelope, including the number of OREI structures and auxiliary platforms outside the main generator site.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
difficulty or danger to vessels underway, performing normal operations, or anchoring.			***Section 7: Emergency Response Overview and Assessment.*** *Summarises the emergency response features of the area.* ***Section 8: Maritime Incidents.*** *Reviews the maritime incidents that have occurred in the vicinity of the OREI over the last 10 years.* ***Section 9: Maritime Traffic Surveys.*** *Considers whether any features of the OREI could pose a danger to vessels underway, performing normal operations or anchoring.* ***Section 10: Review of Shipping Activity.*** *Assesses the impact of the OREI on all vessel types.* ***Section 11: Fishing Vessel Activity.*** *Assesses the impact of the OREI on vessels engaged in fishing or transiting to fishing grounds.* ***Section 12: Recreational Vessel Activity.*** *Assesses the impact of the OREI on vessels engaged in recreational activities.* ***Section 13: Consultation.*** *Summarises consultation regarding whether any features of the OREI could pose a danger to vessels underway, performing normal operations or anchoring.* ***Section 15: Formal Safety Assessment and Appendix A.*** *Summarises Hazard Review Workshop regarding whether any features of the OREI could pose a danger to vessels underway, performing normal operations or anchoring.* ***Section 16: Risk Modelling and Assessment.*** *Assesses the impact that the OREI will have upon vessel-to-vessel collisions, and vessel to structure allision (powered and drifting). Present a summary of results from modelling used to assess whether any features of the OREI could pose any type of difficulty or danger to vessels underway, performing normal operations, or anchoring.*
Clearances of wind turbine blades above the sea surface *not less*	✓		*Not applicable.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
than 22 metres			
Least depth of current turbine blades	✓		***Section 4.3: Project Description Details – Technology*** *All turbines will have a minimum blade clearance from blade tip to sea surface at LAT of 30m.*
The burial depth of cabling	✓		***Section 4.3: Project Description Details – Offshore Components*** *All cables will have to be surface laid due to hard rock substrate preventing burial. Cable protection will be required along the full length of the cable route.*
b. Whether any feature of the installation could create problems for emergency rescue services, including the use of lifeboats, helicopters and emergency towing vessels (ETVs)	✓		***Section 7: Emergency Response Overview and Assessment.*** *Summarises the existing emergency response resources in the region and details how they meet the MCA's requirements.* *Summarises SAR helicopter assets in the vicinity of the Project.* *Summarises RNLI lifeboat stations in the vicinity and response times of their vessels to the Project* *Reviews how modernisation of HM Coastguard will impact upon emergency response in the vicinity of the Project* *Examines options for salvage in the vicinity of the Project. Determines whether the installation could create problems for salvage vessels.*
c. With respect to specific OREI devices, how rotor blade rotation, other exposed moving mechanical parts and/or power transmission, etc., will be controlled by the designated services when this is required in an emergency.	✓		***Section 20: Risk Mitigation Measures & Monitoring.*** *States that the Project will meet the MCA's requirements in terms of standards and procedures for generator shutdown and other operational requirements in the event of this being required in an emergency.* *Developers will require to consult and liaise with the local RNLI stations and the Coastguard about the devices to be deployed and provide any further information requested to assist SAR efforts.*
4. Assessment of Access to and Navigation Within, or Close to, an OREI: To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:			

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
a. Navigation within or close to the site would be safe:			
i. by all vessels, or ii. by specified vessel types, operations and/or sizes. iii. in all directions or areas, or iv. in specified directions or areas. v. in specified tidal, weather or other conditions	✓ ✓ ✓ ✓ ✓		***Section 9: Maritime Traffic Surveys.*** *Reviews traffic survey to determine whether navigation within the site would be safe.* ***Section 10: Review of Shipping Activity.*** *Examines other vessel activity within the area based on the survey data.* ***Section 11: Fishing Vessel Activity.*** *Reviews fishing vessel activity in the area based on the Maritime Traffic Surveys, Marine Scotland surveillance (sightings and satellite) data, Crown Estate Succorfish data, Marine Scotland ScotMap data, research work reported in the Commercial Fisheries Chapter, and consultation undertaken at all stages of the Project and at the Hazard Workshop.* ***Section 12: Recreational Vessel Activity Analysis.*** *Examines recreational vessel activity in the area based on the Maritime Traffic Survey, RYA data, Marine Scotland Shipping Study, additional desktop information, and consultation undertaken at all stages of the Project and at the Hazard Workshop.* ***Section 8: Maritime Incidents.*** *Reviews the maritime incidents that have occurred in the vicinity of the OREI over the last 10 years.* ***Section 13: Consultation.*** *Feasibility of navigation discussed during consultation with a number of relevant stakeholders.* ***Section 16: Risk Modelling and Assessment.*** *Quantitatively assessed hazards of transiting vessel allision, drifting vessel allision and qualitatively reviews the change in vessel-to-vessel collision.*
b. Navigation in and/or near the site should be:			
i. prohibited by specified vessels types, operations and/or	✓		*Relevant sections are cross-referenced under point a (above).*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
sizes. ii. prohibited in respect of specific activities, iii. prohibited in all areas or directions, or iv. prohibited in specified areas or directions, or v. prohibited in specified tidal or weather conditions, or simply vi. recommended to be avoided.	✓ ✓ ✓ ✓ ✓		
c. Exclusion from the site could cause navigational, safety or routeing problems for vessels operating in the area. e.g by causing a vessel or vessels to follow a less than optimum route	✓		*Relevant sections are cross-referenced under point a (above).*
Relevant information concerning a decision to seek a "safety zone" for a particular site during any point in its construction, operation or decommissioning should be specified in the Environmental Statement accompanying the development application	✓		***Section 20: Risk Mitigation Measures.***
Annex 2 : Navigation, collision avoidance and communications			
1. The Effect of Tides and Tidal Streams : *It should be determined whether:*			
i. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓		***Section 4: Project Description Details.*** *States the depth of water in which the proposed installations are to be situated.* ***Section 6: Metocean Data.*** *Examines various states of the tide in the area.* ***Section 8: Maritime Incidents.*** *Reviews maritime incidents that have occurred in the vicinity of the Project over the last 10 years including those related to the water depth.* ***Section 9: Maritime Traffic Surveys*** *Assesses current maritime traffic flows and operations in the general area.* ***Section 16: Risk Modelling and Assessment.***

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			COLLRISK models take into account tides in the vicinity of the Project.
ii. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	✓		***Section 8: Metocean Data.*** *Examines various states of the tide in the area.* ***Section 16: Risk Modelling and Assessment.*** *COLLRISK models take into account tides in the vicinity of the Project.*
iii. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓		***Section 6: Metocean Data.*** *Examines various states of the tide in the area.*
iv. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓		***Section 6: Metocean Data.*** *Examines various states of the tide in the area.*
v. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream.	✓		***Section 6: Metocean Data.*** *Examines various states of the tide in the area.* ***Section 16: Risk Modelling and Assessment.*** *COLLRISK models take into account tides in the vicinity of the Project.*
vi. The structures themselves could cause changes in the set and rate of the tidal stream.	✓		*Refer to coastal processes study.*
vii. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area	✓		*Refer to coastal processes study.*
2. Weather: *It should be determined whether:*			
i. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓		***Section 6: Metocean Data.*** *Presents metocean statistics for the area.* ***Section 8: Maritime Incidents.*** *Reviews maritime incidents that have occurred in the vicinity of the Project over the last 10 years including those related to bad weather or restricted visibility.* ***Section 9: Maritime Traffic Surveys.*** *Assesses routeing of vessels which pass in close proximity to the site based on conditions experienced during 2 x 14 days summer and winter.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			Section 16: Risk Modelling and Assessment. *Risk models take into account all-year weather conditions in the vicinity, including probability of fog.*
ii. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓		*Not applicable due to submerged devices.*
iii. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to in 2.1 - v. above	✓		***Section 15: Formal Safety Assessment and Appendix A.*** *Drifting vessels discussed during the Hazard Review Workshop.* ***Section 16: Risk Modelling and Assessment.*** *Drifting Ship Allision model assesses whether vessels could drift into danger. The model has been run for different combinations of wind and tide and the worst-case result reported in the assessment.*
3. Visual Navigation and Collision Avoidance: *It should be determined whether:*			
i. The structures could block or hinder the view of other vessels under way on any route.	✓		*Not applicable as there are no surface-piercing elements in the design.*
ii. The structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories, etc.	✓		*Not applicable as there are no surface-piercing elements in the design.*
4. Communications, Radar and Positioning Systems : *To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:*			
i. The structures could produce radio interference such as shadowing, reflections or phase changes, with respect to any frequencies used for marine positioning, navigation or communications, including Automatic Identification Systems (AIS), whether ship borne, ashore or fitted to any of the proposed structures.	✓		***Section 19.7: Loss of Station and Other Navigation Issues – Electromagnetic Interference on Navigation Equipment.*** *As the turbines are subsea, they should have no impact on marine radar or other electronics devices such as VHF, GPS, AIS or LORAN.*
ii. The structures could produce radar reflections, blind spots, shadow areas or other adverse effects:			***Section 19.7: Loss of Station and Other Navigation Issues – Electromagnetic Interference on Navigation Equipment.*** *Determines whether the structures could*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
a. Vessel to vessel; b. Vessel to shore; c. VTS radar to vessel; d. Racon to/from vessel.	✓ ✓ ✓ ✓		*produce radar reflections, blind spots, shadow areas or other adverse effects.*
iii. The OREI, in general, would comply with current recommendations concerning electromagnetic interference.	✓		***Section 19.7: Loss of Station and Other Navigation Issues – Electromagnetic Interference on Navigational Equipment.*** *Noted that the OREI would comply with current recommendations concerning electromagnetic interference.*
iv. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓		***Section 19.6: Loss of Station and Other Navigation Issues – Structures and Generators Affecting Sonar Systems in Area.*** *Indicates that no evidence has been found regarding sonar interference.*
v. The site might produce acoustic noise which could mask prescribed sound signals.	✓		***Section 19.8: Additional Navigation Issues – Noise Impact.*** *Reviews potential for noise impact.*
vi. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✓		***Section 19.7: Additional Navigation Issues – Electromagnetic Interference on Navigation Equipment.*** *Reviews potential electromagnetic interference on navigation equipment from the Project.*
5. Marine Navigational Marking : *It should be determined:*			
i. How the overall site would be marked by day and by night taking into account that there may be an ongoing requirement for marking on completion of decommissioning, depending on individual circumstances.	✓		***Section 4: Project Description Details.*** *Details that the Project will have no surface piercing elements and also the vessels likely to be involved in construction, maintenance and decommissioning.* ***Section 13: Consultation.*** *Consultation on lighting and marking of the Project, including NLB.* ***Section 20: Risk Mitigation Measures.*** *The Project will be marked and lit (if required) according to NLB and MCA requirements.*
ii. How individual structures on the perimeter of and within the site, both above and below the sea surface, would be marked by day and by night.	✓		*Relevant sections are cross-referenced under point i. (above).*
iii. If the specific OREI structure	✓		*Relevant sections are cross-referenced under*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
would be inherently radar conspicuous from all seaward directions - and for SAR and maritime surveillance aviation purposes or would require passive enhancers.			*point i. (above).*
iv. If the site would be marked by one or more radar beacons (Racons)	✓		*Relevant sections are cross-referenced under point i. (above).*
v. If the site would be marked by an Automatic Identification System (AIS) transceiver, and if so, the data it would transmit.	✓		*Relevant sections are cross-referenced under point i. (above).*
vi. If the site would be fitted with a sound signal, and where the signal or signals would be sited	✓		*Relevant sections are cross-referenced under point i. (above).*
vii. If the structure(s) would be fitted with aviation marks, and if so, how these would be screened from mariners or potential confusion with other navigational marks and lights resolved	✓		*Not Applicable*
viii. Whether the proposed site and/or its individual generators would comply in general with markings for such structures, as required by the relevant International Association of Marine Aids to Navigation and Lighthouses or recommended by the Maritime and Coastguard Agency, respectively.	✓		*Relevant sections are cross-referenced under point i. (above).*
ix. The aids to navigation specified by the GLAs are being maintained such that the 'availability criteria', as laid down and applied by the GLAs, is met at all times. Separate detailed guidance is available from the GLAs on this matter.	✓		*Relevant sections are cross-referenced under point i. (above).*
x. The procedures that need to be put in place to respond to casualties to the aids to navigation specified by the	✓		*Relevant sections are cross-referenced under point i. (above).*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
GLAs, within the timescales laid down and specified by the GLAs.			
6. Hydrography: In order to establish a baseline, detailed and accurate hydrographic surveys are required to IHO Order 1a standard multibeam bathymetry with final data being supplied as a digital full density data set, and erroneous soundings flagged as deleted but include in the data set. A full report detailing survey methodology and equipment should accompany the surveys.			
Annex 3: MCA template for assessing distances between wind farm boundaries and shipping routes			
Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning.			
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the Environmental Impact Assessment (EIA). The specific measures to be employed will be selected in consultation with the Maritime and Coastguard Agency and will be listed in the developer's Environmental Statement (ES). These will be consistent with international standards contained in, for example, the Safety of Life at Sea (SOLAS) Convention - Chapter V, IMO Resolution A.572 - 14.3 and Resolution A.671 - 16.4 and could include any or all of the following:	✓		***Section 15: Formal Safety Assessment and Appendix A.*** *Reviewed mitigation and safety measures appropriate to the OREI development at Hazard Review Workshop.*
i. Promulgation of information and warnings through notices to mariners and other appropriate media.	✓		***Section 15: Formal Safety Assessment and Appendix A.*** *Promulgation of information and warnings through notices to mariners and other appropriate media discussed as mitigation during Hazard Review Workshop.*
ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).	✓		***Section 17.4: Construction and Decommissioning – Other Mitigation Measures.*** *Recommendation for DSC during construction and decommissioning.* ***Section 20: Risk Mitigation Measures.***

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			During work at the site there will be continuous watch by VHF including DSC.
iii. Safety zones of appropriate configuration, extent and application to specified vessels	✓		***Section 15: Formal Safety Assessment and Appendix A.*** *Discussed at Hazard Review Workshop.* ***Section 17: Construction and Decommissioning Impacts.*** Discusses safety zones during construction and decommissioning phases of the Project. ***Section 20: Risk Mitigation Measures.*** *Mitigation measures adopted by project.*
iv. Designation of the site as an area to be avoided (ATBA).	✓		*Not applicable.*
v. Implementation of routeing measures within or near to the development.	✓		*Not applicable.*
vi. Monitoring by radar, AIS and/or closed circuit television (CCTV).	✓		***Section 20: Risk Mitigation Measures.*** *Mitigation measures under consideration by project.*
vii. Appropriate means to notify and provide evidence of the infringement of safety zones or ATBAs.	✓		***Section 20: Risk Mitigation Measures.*** *Mitigation measures adopted by project includes guard vessel during construction.*
viii. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓		*Relevant sections are cross-referenced above at beginning of Annex 4.*
ix. Creation of an Emergency Response Cooperation Plan with the relevant Maritime Rescue Coordination Centre - from construction phase onwards.	✓		***Section 7.4: Emergency Response Overview and Assessment – Project SAR Matters.*** *An ERCoP will be in place prior to construction being undertaken.* ***Section 13: Consultation.*** *ERCoP discussed during consultation process.* ***Section 19.2: Loss of Station and Other Navigation Issues – Loss of Station.*** *Emergency response procedures to be detailed within ERCoP.*
Annex 5: Standards and procedures for wind turbine generator shutdown in the event of a search and rescue, counter pollution or salvage incident in or around a wind farm. Where also applicable to tidal turbines comments have been added.			
1. Design Requirements: The OREI should be designed and constructed to satisfy the following design requirements for emergency rotor shut-down in the event of a search and			

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
rescue - SAR., counter pollution or salvage operation in or around a wind farm or other OREI site:			
i. All wind turbine generators (WTGs) and other OREI individual structures will each be marked with clearly visible unique identification characters which can be seen by both vessels at sea level and aircraft - helicopters and fixed wing. from above.	✓		*Not applicable as there are no surface-piercing elements in the design.*
ii. The identification characters shall each be illuminated by a low-intensity light visible from a vessel thus enabling the structure to be detected at a suitable distance to avoid a collision with it. The size of the identification characters in combination with the lighting should be such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer, stationed 3 metres above sea levels, and at a distance of at least 150 metres from the turbine. It is recommended that lighting for this purpose be hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation marks. (Precise dimensions to be determined by the height of lights and necessary range of visibility of the identification numbers.)	✓		*Not applicable*
iii. For aviation purposes, OREI structures should be marked with hazard warning lighting in accordance with CAA guidance and also with unique identification numbers - with illumination controlled from the site control centre and activated	✓		*Not applicable*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
as required. On the upper works of the OREI structure so that aircraft can identify each installation from a height of 500ft (150 metres) above the highest part of the OREI structure.			
iv. Wind Turbine Generators (WTGs) shall have high contrast markings (dots or stripes) placed at 10 metre intervals on both sides of the blades to provide SAR helicopter pilots with a hover reference point.	✓		*Not applicable to tidal turbines*
v. All OREI generators and transmission systems should be equipped with control mechanisms that can be operated from the OREI Central Control Room or through a single contact point.	✓		*Design will meet MCA requirements.*
vi. Throughout the design process for an OREI, appropriate assessments and methods for safe shutdown should be established and agreed, through consultation with MCA Navigation safety Branch, Search and Rescue Branch and other emergency support services.	✓		*Design will meet MCA requirements.*
vii. The OREI control mechanisms should allow the Control Room Operator to fix and maintain the position of the WTG blades, nacelles and other appropriate OREI moving parts to configurations determined by the Maritime Rescue Co-ordination Centre (MRCC). This same operator must be able to immediately effect the control of offshore substations and export cables.	✓		*Not applicable to tidal turbines*
viii. Nacelle hatches and other OREI enclosed spaces in which	✓		*Not applicable to tidal turbines.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
personnel are working should be capable of being opened from the outside. This will allow rescuers (e.g. helicopter winch-man) to gain access to the tower if tower occupants are unable to assist and when sea-borne approach is not possible.			
ix. Access ladders, although designed for entry by trained personnel using specialised equipment and procedures for turbine maintenance in calm weather, could conceivably be used, in an emergency situation, to provide refuge on the turbine structure for distressed mariners. This scenario should therefore be considered when identifying the optimum position of such ladders and take into account the prevailing wind, wave and tidal conditions.	✓		*Not applicable to tidal turbines.*
x. Although it may not be feasible for mariners in emergency situations to be able to use wave or tidal generators as places of refuge, consideration should nevertheless be given to the provision of appropriate facilities.	✓		*Not applicable to submerged tidal turbines.*
2. Operational Requirements			
i. The Central Control Room, or mutually agreed single point of contact, should be manned 24 hours a day.	✓		*Design will meet MCA requirements.*
ii. The Central Control Room, or mutually agreed single point of contact, should have a chart indicating the Global Positioning System (GPS) position and unique identification numbers of each of the WTGs in the wind farm, or individual devices in other types of OREI.	✓		*Design will meet MCA requirements.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
iii. All MRCCs will be advised of the contact telephone number of the Central Control Room, or mutually agreed single point of contact.	✓		*Design will meet MCA requirements.*
iv. All MRCCs will have a chart indicating the GPS position and unique identification number of each of the WTGs in all wind farms or all devices in other types of OREI.	✓		*Design will meet MCA requirements.*
v. All search and rescue helicopter bases will be supplied with an accurate chart of all the OREI and their GPS positions.	✓		*Design will meet MCA requirements.*
vi. The Civil Aviation Authority shall be supplied with accurate GPS positions of all OREI structures for civil aviation navigation charting purposes	✓		*Not applicable as there are no surface-piercing elements in the design.*
3. Operational Procedures			
i. Upon receiving a distress call or other emergency alert from a vessel which is concerned about a possible collision with a WTG or is already close to or within the wind farm, or when the MRCC receives a report that persons are in actual or possible danger in or near a wind farm and search and rescue aircraft and/or rescue boats or craft are required to operate over or within the wind farm, the MRCC/SC will establish the position of the vessel and the identification numbers of any WTGs which are visible to the vessel. This information will be passed immediately to the Central Control Room, or single contact point, by the MRCC. A similar procedure will be followed when vessels are close to or within other types of OREI site.	✓		*Design will meet MCA requirements.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
ii. The control room operator, or single point of contact, should immediately initiate the shut-down procedure for those WTGs as requested by the MRCC and maintain the WTG in the appropriate shut-down position, again as requested by the MRCC, or as agreed with MCA Navigation Safety Branch or Search and Rescue Branch for that particular installation, until receiving notification from the MRCC that it is safe to restart the WTG.	✓		*Design will meet MCA requirements.*
iii. The appropriate procedure to be followed in respect of other OREI types, designs and configurations will be determined by these MCA branches on a case by case basis, in consultation with appropriate stakeholders, during the Scoping and Environmental Impact Assessment processes	✓		*Design will meet MCA requirements.*
iv. Communication procedures should be tested satisfactorily at least twice a year. Shutdown and other procedures should be tested as and when mutually agreed with the MCA.	✓		*Design will meet MCA requirements.*

Offshore Renewable Energy Installations

Methodology for Assessing the Marine Navigational Safety Risks of OREIs - Compliance with recommended DTI Methodology.

General Comments:

Section	Yes	No	Reference notes/Remarks
A1: Overview and guidance on navigation safety issues.	✓		*Section 2: Guidance, Legislation and Consultation.*
A2: Overview of FSA.	✓		*Section 2: Guidance, Legislation and Consultation.* *Section 15: Formal Safety Assessment.*
A3: Lessons learned.	✓		*Section 3.6: Data Sources – Lessons Learned.* *Entire NRA takes into account Lessons Learned within the offshore industry.*
B1: Base case traffic densities and types.	✓		*Section 9: Maritime Traffic Surveys.* *Section 10: Review of Shipping Activity.* *Section 11: Fishing Vessel Activity.* *Section 12: Recreational Vessel Activity.*
B2: Future traffic densities and types.	✓		*Section 16: Risk Modelling and Assessment.*
B3: The marine environment :			
B3.1 Technical & operational analysis	✓		*Section 6: Project Description Details.*
B3.2 Generic TOA	✓		*Section 9: Maritime Traffic Surveys.*
B3.3 Potential accidents	✓		*Section 15: Formal Safety Assessment and Appendix A.* *Section 16: Risk Modelling and Assessment.*
B3.4 Affected navigational activities	✓		*Section 9: Maritime Traffic Surveys.* *Section 10: Review of Shipping Activity.* *Section 11: Fishing Vessel Activity.* *Section 12: Recreational Vessel Activity.* *Section 15: Formal Safety Assessment and Appendix A.* *Section 16: Risk Modelling and Assessment.*
B3.5 Effects of wind farm structures	✓		*Section 16: Risk Modelling and Assessment.*
B3.6 Development phases	✓		*Section 4: Project Description Details.*
B3.7 Other structures & features	✓		*Section 4: Project Description Details*
B3.8 Vessel types involved	✓		*Section 9: Maritime Traffic Surveys.* *Section 10: Review of Shipping Activity.* *Section 11: Fishing Vessel Activity.*

Section	Yes	No	Reference notes/Remarks
			Section 12: Recreational Vessel Activity.
B3.9 Conditions affecting navigation	✓		*Section 6: Metocean Data* *Section 16: Risk Modelling and Assessment.*
B3.10 Human actions	✓		*Section 9: Maritime Traffic Surveys.* *Section 10: Review of Shipping Activity.* *Section 11: Fishing Vessel Activity.* *Section 12: Recreational Vessel Activity.* *Section 15: Formal Safety Assessment and Appendix A.*
C1: Hazard Identification	✓		*Section 15: Formal Safety Assessment and Appendix A.*
C2: Risk Assessment	✓		*Section 15: Formal Safety Assessment and Appendix A.*
C3: Hazard log	✓		*Section 15: Formal Safety Assessment and Appendix A.*
C4: Level of risk	✓		*Section 15: Formal Safety Assessment and Appendix A.*
C5: Influences on level of risk	✓		*Section 15: Formal Safety Assessment and Appendix A.* *Section 16: Risk Modelling and Assessment.*
C6: Tolerability of residual risk	✓		*Section 15: Formal Safety Assessment and Appendix A.*
D1 : Appropriate risk assessment	✓		*Entire NRA Document.*
D2 : MCA approval for assessment tools and techniques	✓		*Section 3: Data Sources.* *Section 15: Formal Safety Assessment and Appendix A.*
D3: Demonstration of results	✓		*Section 15: Formal Safety Assessment and Appendix A.*
D4 : Area traffic assessment	✓		*Section 9: Maritime Traffic Surveys.* *Section 10: Review of Shipping Activity.* *Section 11: Fishing Vessel Activity.* *Section 12: Recreational Vessel Activity.*
D5 : Specific traffic assessment	✓		*Section 9: Maritime Traffic Surveys.* *Section 10: Review of Shipping Activity.* *Section 11: Fishing Vessel Activity.* *Section 12: Recreational Vessel Activity.* *Appendix B: PHA AIS Surveys.*
E1 : Risk control log	✓		*Section 15: Formal Safety Assessment and Appendix A.*
E2 : Cost benefit assessment	✓		*Section 15: Formal Safety Assessment and Appendix A.*
E3 : Assessment of equity to	✓		*Assessment of equity to stakeholders will be*

Section	Yes	No	Reference notes/Remarks
stakeholders			*carried out if required.*
F1: Tolerability of risk claim	✓		*Section 15: Formal Safety Assessment and Appendix A.*
G1 : Hazard identification checklist	✓		*Section 15: Formal Safety Assessment and Appendix A.*
G2 : Risk control checklist	✓		*Section 15: Formal Safety Assessment and Appendix A.*
G3 : MCA MGN 371 compliance checklist	✓		*Appendix C: MGN 371 Checklist.*